Office of the Chief of Engineers
Value Engineering Study Team

US Army Corps of Engineers

OVEST

VALUE ENGINEERING TEAM STUDY REPORT

Greenup Lock

OHIO RIVER

Sponsored By:
U.S. Army Engineer District, Huntington

FEBRUARY 2001

VALUE ENGINEERING TEAM STUDY

DOD SERVICE: USACE
CONTROL NO:
VALUE ENGINEERING OFFICER: Greg Jones

Value Engineering Study on the

Greenup Lock

OHIO RIVER

February 2001

U.S. Army Engineer District, Huntington

VALUE ENGINEERING FIRM NAME: OVEST
ADDRESS: 100 West Oglethorpe Avenue
Savannah, Georgia 31401
PHONE: (912) 652-5448

VALUE ENGINEERING STUDY TEAM LEADER: WARREN WITHERS
912-652-5958

VALUE ENGINEERING STUDY TEAM MEMBERS

Greg Jones
Darin White
David Schaaf
David Conley
James (Arnie) McCoy
Lisa Pierce
Jose Van Rijen
Eara Merritt
Fred McAuley
Sean Smith
David Carter
Thomas Sully
Eric Dolly
Richard Stockstill
Henkjam Berkhoff
John Koontz
Charles Claghorn
Warren Withers

VALUE ENGINEERING TEAM STUDY

TABLE OF CONTENTS

Page No.

Cover 1

Table of Contents 2

Project Description and Background 4

Executive Summary 5

Summary of Proposals 6

Proposals:

C-1 Eliminate Guidewall Extensions, Extend Only Landside Guidewalls 8

C-2 Reduce Lengths of All Approach Wall Extensions 14

C-3 Eliminate Filling System 19

C-4 Use a Siphon versus Deep Gravity Culvert Filling System 22

C-5 Manifold Intake on Upstream side Wall 26

C-6 Use Excavated Rock for Cell Fill Placement 30

C-7 Place F/E System for Extension Landside Lockwall and Bridge Pier 32

C-8 Drilled Shaft Wall (Anchored) 36

C-9 Drilled Shaft Landwall (Doubled) 41

C-10 Eliminate Crossover Discharge, Route Behind Landside Guidewall 46

C-11 Add Sluice Gate and Culvert to Empty Dry Dock 52

C-12 Lift-in-Place Alternatives 56

C-13 Compare Float-In versus Lift-In 62

TABLE OF CONTENTS (continued)

Page No.

C-14 Float-In Version of Tin Can Concept 67

C-15 Straighten Culvert 74

C-16 Same Alignment by Micro-Tunnel versus Braced Open Excavation 77

C-17 Culvert next to Lockwall, Micro-Tunnel at Tower, Shore against Lock 80

C-18 Incorporate the Fill Valve into the Landwall Extension 82

C-19 Make Downstream Entry Point as Far Downstream as Possible 86

C-20 Use a Downstream Pump Station for New Filling Capacity 90

C-21 Skirt Material 94

C-22 In-Floor Supplemental Filling/Emptying System 99

C-23 Though-the-Sill Filling/Emptying System 103

C-24 Use Standard Lighting versus High-Mast Lighting 106

C-25 Reduce Number of Armor Strips on Guide Wall 110

Value Engineering Comments 114

Supporting Documents:

Appendix A: Contact Directory

Appendix B: Speculation and Analysis List

Appendix C: Cost Model

Appendix D: Function Analysis System Technique (FAST) Diagram

Appendix E: Supporting Information

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE: Greenup Lock
PROJECT LOCATION: Ohio River

This project involves the expanding the capacity of the existing lock and dam along the Ohio River Mainstream System. The design intends to upgrade the existing facility to a 110-foot by 1,200-foot lock.

Currently, the existing upstream approach conditions are less than desirable. The crosscurrents encountered by barges approaching the lock forces them to flank the bank with the nose being pulled toward the river. In order to ensure an adequate landing zone for the main and auxiliary chamber, the approach walls will be lengthened and configured to allow a 1,200-foot landing zone for each chamber. Due to crosscurrents, general river and navigation conditions, extensive modeling will be performed to optimize the approach conditions and shorten the walls (landing zones) as much as possible.

As part of the Value Engineering (VE), alternative designs were reviewed. Various configurations were examined and comments were explored. The results of the study are the contents of this report.

VALUE ENGINEERING TEAM STUDY
EXECUTIVE SUMMARY

Value Engineering is a process used to study the functions a project is to provide. As a result, it takes a critical look at how these functions are met and develops alternative ways to achieve the same function while increasing the value of the project. In the end, it is hoped that the project will realize a reduction in cost, but adding value over reducing cost is the focus of VE.

The Value Engineering Study was initiated during the VE workshop/conference conducted 12 through 16 February, 2001. The study was based on the District's Interim Feasibility Report: J.T. Myers and Greenup Lock Improvements, and a report from INCA Engineers Inc., Ohio River Mainstem Systems Study, Greenup Locks & Dam Approach Walls. A site tour was conducted with the Huntington District Design Team, the Value Engineering Officer, and OVEST Team Members on 12 February, 2001.

The project was studied using the Corps of Engineers standard Value Engineering (VE) methodology, consisting of five phases:

Information Phase: The Team studied drawings, figures, descriptions of project work, and cost estimates to fully understand the work to be performed and the functions to be achieved. Cost Models (see Appendix C) were compared to determine areas of relative high cost to ensure that the team focused on those parts of the project which offered the most potential for cost savings.

Speculation Phase: The Team speculated by conducting brainstorming sessions to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged (see Appendix B).

Analysis Phase: Evaluation, testing and critical analysis of all ideas generated during speculation was performed to determine potential for savings and possibilities for risk. Ideas were ranked by priority for development

Development Phase: The priority ideas were developed into written proposals by VE team members during an intensive technical development session. Proposal descriptions, along with sketches, technical support documentation, and cost estimates were prepared to support implementation of ideas. Additional VE Team Comments were included for items of interest which were not developed as proposals, and these comments follow the study proposals.

Presentation Phase: Presentation is a two-step process. First, the published VE Study Report is distributed for review by project supporters and decision-makers. The formal, oral presentation of the VE Study Proposals will be coordinated through the District.

VALUE ENGINEERING TEAM STUDY
SUMMARY OF PROPOSALS

This Value Engineering Study resulted in the following proposals which can result in significant savings for this project:

PROPOSAL	DESCRIPTION	POTENTIAL SAVINGS
C-1	Eliminate Guidewall Extensions, Extend Only Landside Guidewalls	$24,301,524
C-2	Reduce Lengths of All Approach Wall Extensions	$14,028,848
C-3	Eliminate Filling System	$18,000,000
C-4	Use a Siphon versus Deep Gravity Culvert Filling System	$11,853,020
C-5	Manifold Intake on Upstream side Wall	$3,617,118
C-6	Use Excavated Rock for Cell Fill Placement	$4,654,500
C-7	Place F/E System for Extension Landside Lockwall and Bridge Pier	$2,590,777
C-8	Drilled Shaft Wall (Anchored)	$3,959,500
C-9	Drilled Shaft Landwall (Doubled)	$900,550
C-10	Eliminate Crossover Discharge, Route Behind Landside Guidewall	$2,748,960
C-11	Add Sluice Gate and Culvert to Empty Dry Dock	$481,314
C-12	Lift-in-Place Alternatives	$991,750
C-13	Compare Float-In versus Lift-In	$660,500
C-14	Float-In Version of Tin Can Concept	$1,700,000
C-15	Straighten Culvert	$1,534,076
C-16	Same Alignment by Micro-Tunnel versus Braced Open Excavation	$1,556,644
C-17	Culvert next to Lockwall, Micro-Tunnel at Tower, Shore against Lock	$1,325,760

PROPOSAL	DESCRIPTION	POTENTIAL SAVINGS
C-18	Incorporate the Fill Valve into the Landwall Extension	$1,074,105
C-19	Make Downstream Entry Point as Far Downstream as Possible	$2,921,235
C-20	Use a Downstream Pump Station for New Filling Capacity	$357,020
C-21	Skirt Material (carbon steel)	$615,542
	Skirt Material (synthetic)	$1,277,250
C-22	In-Floor Supplemental Filling/Emptying System	$2,200,000
C-23	Though-the-Sill Filling/Emptying System	$10,200,000
C-24	Use Standard Lighting versus High-Mast Lighting	$120,000
C-25	Reduce Number of Armor Strips on Guide Wall	$240,979

DESCRIPTION: Eliminate Guidewall Extensions, Extend Only Landside Guidewalls

ORIGINAL DESIGN:

Upstream middle approach wall (UMW) of the extended lock will be increased in length to correspond with general guidance for 1,200-foot locks. In conjunction with this extension the riverward approach wall (URW) for the existing 1,200-foot riverward lock must be extended 1,200 feet as well. Downstream landside approach wall of the extended lock (LLW) will be increased to 1,200 feet. Riverside guardwall (LRW) will be extended to terminate in parallel with the landside guidewall. (See Drawing No. 1).

PROPOSED DESIGN:

Do not extend upstream riverside guardwall (URW) and upstream middle wall (UMW). Do not demolish existing upstream landside wall. Extend upstream landside guidewall 800 feet. Relocate harbor area farther upstream. (See Drawing No. 2).

ADVANTAGES:

1. Keeps maintenance conditions same as conditions for existing lock.
2. Keeps navigation conditions same as for existing riverside lock, which is already 1,200 feet in length.
3. Reduced middle wall length facilitates upstream entry to landside lock.
4. Shorter upstream guide/guardwall lengths will reduce entry/exit time to/from lock chamber, reducing overall lockage time.
5. Less construction adjacent to existing operational lock chamber will result in reduced downtime from required construction closures and reduced interference to river traffic patterns.
6. Reduces construction placement and contract time.
7. Removes obstructions (wall extensions) in the approach channels.
8. Reduces potential for accidents during construction adjacent to the operational lock channel.
9. Retains 250 foot wide open forebay to lock to facilitate navigation.
10. Reduces overall lockage time.
11. Reduces accumulation of ice and debris in the longer approach walls.
12. Reduces O&M and downtime due to increased ice/debris accumulation.

DISADVANTAGES:

1. Operation of both locks simultaneously may be more difficult.

JUSTIFICATION:

The purpose of extending the existing 600 foot lock to 1,200 feet is so that the existing 1,200 foot lock can be shut down for an extended maintenance/rehabilitation period without impacting lockage times (splitting tows to pass the 600 foot lock) on the river. Consider that generally both locks will not be locking vessels through simultaneously. Only one lock will be in operation at any one time. If the riverward lock is closed for maintenance, then only the landside lock is operational, and only the landside walls are needed for lay-up of tows. If the riverward lock only is operational, conditions and requirements for wall lengths are no different that today. No wall extensions are needed for that scenario. Therefore the middle wall extension (UMW) is not required for either case, since only one lock operates for an extended period of time. This negates the need to extend the upper guardwall (URW) as well. Should future traffic increase to the point that simultaneous lockages are required, wall modifications and extensions can easily be made at that time, as required by future conditions. Or operational procedures could be modified at that time designating riverward lock upbound only, landward lock downbound only, mitigating the need for full guard/guidewall extensions upstream/downstream on both locks.

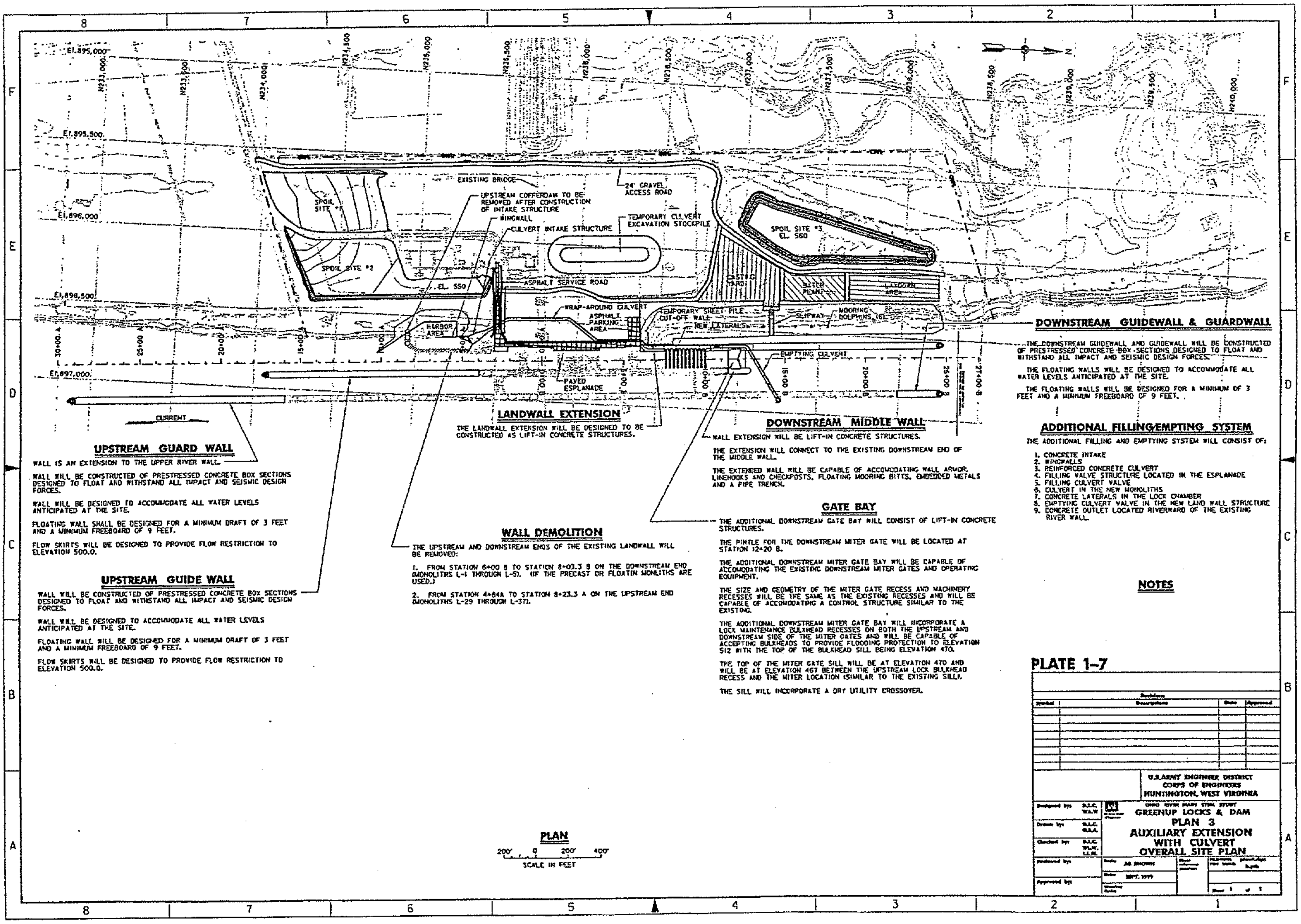
Since existing downstream and upstream approaches for the riverward lock will be unchanged from the existing condition, there is no need to extend the upstream riverward guardwall (URW, LRW) or upstream middle wall (UMW) for approach to the riverward lock. Wall extensions are compounded since extending the upstream middle wall (UMW) dictates that the upstream river wall (URW) be extended an additional 1,200 feet to provide a lay-up area for the riverward lock. Consider that only one lay-up wall is actually needed for each lock chamber, riverwalls for the riverward lock and landwalls for the landward lock. Therefore the upstream middle wall (UMW) should not be extended. This allows a 250 foot width between riverward guardwall and landward guidewall for maneuvering into and out of both lock chambers, which actually facilitates navigation and reduces overall lockage time. Upstream and downstream approaches will now be the same configuration, and both function well under existing conditions. Then the only required change is the lay-up wall lengths for the enlarged landward lock. Tows approaching the new 1,200-foot landward lock can easily line up on the landward guide walls, which can be extended as necessary upstream and downstream to accommodate a 1,200-foot tow versus a 600-foot tow. Extending these walls to a full length of 1,200 feet is probably not necessary as well, but is shown that way in the current plan because guidance recommends that guide/ guard walls be as long as the lock chamber. This is a rule of thumb and is guidance, not a requirement. In reality walls can be significantly shorter and further reduction may be warranted.

Wall lengths must be designed by several physical models to consider not only a navigation model, but also a debris/ice model, since accumulation and removal of debris/ice will be severely affected by extension of the existing wall systems. These wall extensions will trap more debris and ice which no longer can be removed by the current methods of removal. It should be noted that restriction in lock operation because of an increase in debris/maintenance removal time will reduce navigation times and offset gains anticipated or actually lose time overall. Wall extension impacts on navigation times must be carefully weighed between improving navigation times and reducing debris/ice maintenance costs and time losses. Any extensions should show overall improvement in existing operational conditions as well as navigational improvements.

Also note that extension of middle and guide/guard walls creates a narrow trough which slows passage of the tow into/out of the lock chamber, since the tow now has to push against a longer constrained pool of water for both entry and exit. This slows passage and increases overall lockage time.

DRAWING NO 1:

ORIGINAL DESIGN

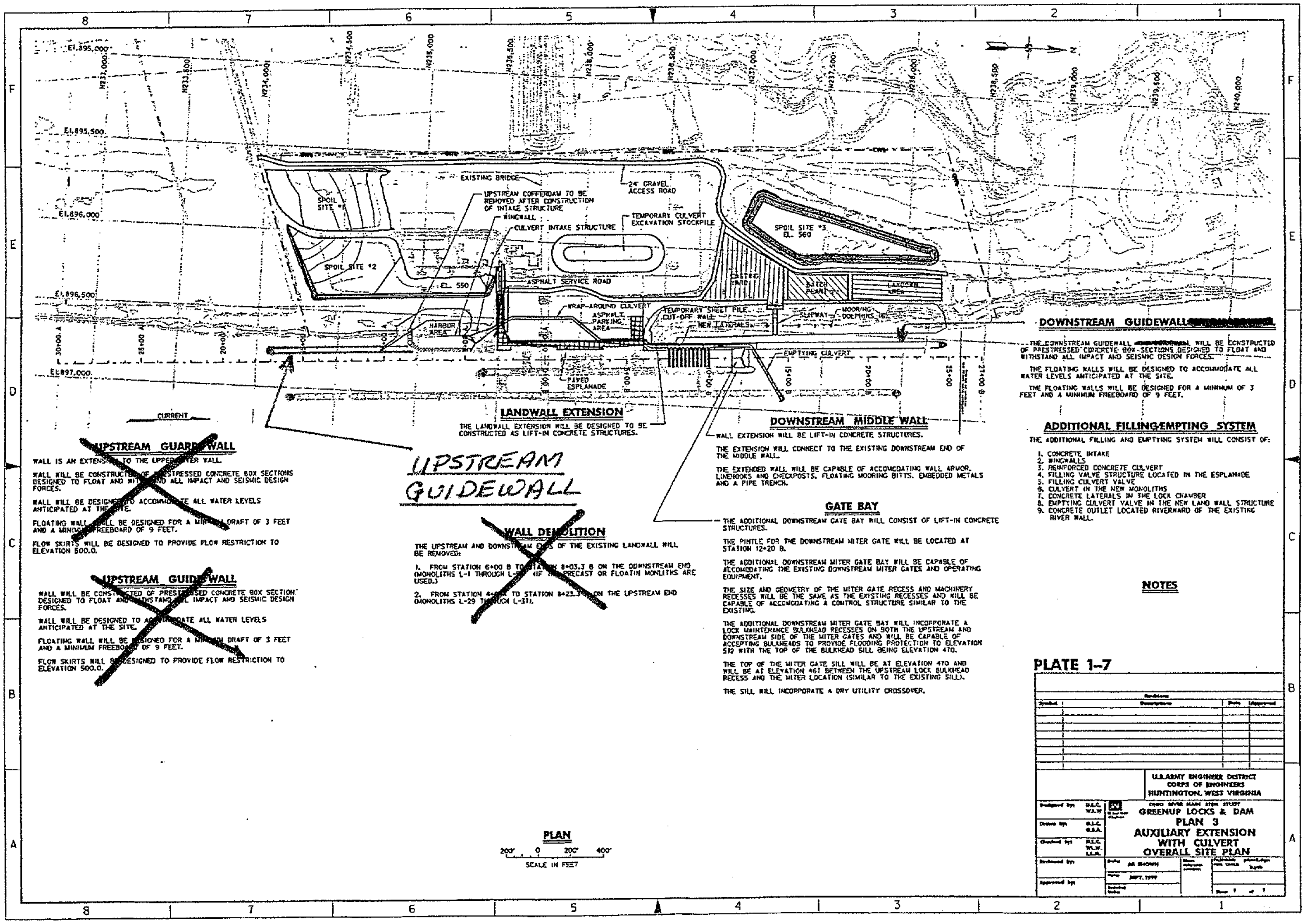


VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-1

DRAWING NO 2:

PROPOSED DESIGN



VALUE ENGINEERING PROPOSAL

COST ESTIMATE WORKSHEET

PROPOSAL NO. C-1: Eliminate Guidewall Extensions, Extend Only Landside Guidewal				PAGE 6 OF 6
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Upstream middle floating wall (UMW)	LF	1,300	$7,215	$9,379,500
Upstream river floating wall (URW)	LF	1,297	$6,739	$8,740,483
Downstream riverside floating wall (LRW)	LF	249	$6,642	$1,653,858
Nose piers	EA	3	$3,583,561	$10,750,683
Pylons	EA	2	$882,633.00	$1,765,266
Remove upstream landside wall (L-29 - L-37)	CY	11,505	$79	$908,895
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$33,198,685
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Extend upstream landside guidewall 800 feet	LF	800	$6,642	$5,313,600
Nose pier	EA	1	$3,583,561	$3,583,561
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$8,897,161
		Net Cost Decrease		$24,301,524
	*	Mark-ups	0.00%	$0
		Total Cost Decrease		$24,301,524

* Unit prices contain mark-ups for OH&P, and escalation & contingency

PROPOSAL NO: C-2
DESCRIPTION: Reduce Lengths of All Approach Wall Extensions

ORIGINAL DESIGN:

Upstream middle approach wall (UMW) of the extended lock will be increased to 1,200 feet in length to correspond with general guidance for 1,200-foot locks. As a result, the riverward approach wall (URW) for the existing 1,200-foot riverward lock must be extended an additional 1,200 feet as well. Downstream landside approach wall of the extended lock (LLW) will also be increased to 1,200 feet. Riverward guardwall (LRW) will be extended to terminate in parallel with the landward guidewall.
(See Drawing No. 1).

PROPOSED DESIGN:

Do not extend all guardwalls upstream and downstream by 1,200 feet (reduce lengths to 800 feet for the purpose of this cost comparison). Do not demolish existing upstream landside wall. Relocate harbor area farther upstream. (See Drawing No. 2).

ADVANTAGES:

1. Keeps maintenance conditions same as conditions for existing lock.
2. Keeps navigation conditions same as for existing riverward lock which is already 1,200 feet in length.
3. Reduced upstream middle wall length facilitates entry to landward lock.
4. Shorter guide/guardwall lengths will reduce entry/exit time to/from lock chamber, reducing overall lockage time.
5. Less construction adjacent to existing operational lock chamber will result in reduced downtime from required construction closures and reduced interference to river traffic patterns.
6. Reduces construction placement and contract time.
7. Removes obstructions (wall extensions) in the approach channels.
8. Reduces potential for accidents during construction adjacent to the operational lock channel.
9. Retains 250-foot wide open forebay to lock to facilitate navigation.
10. Reduces overall lockage time.
11. Reduces accumulation of ice and debris in the longer approach walls.
12. Reduces O&M and downtime due to increased ice/debris accumulation.

DISADVANTAGES:

1. Operation of both locks simultaneously would be more difficult.
2. Tows will not have a wall as long as the string-out (1,200 feet) to lay-up against.

JUSTIFICATION:

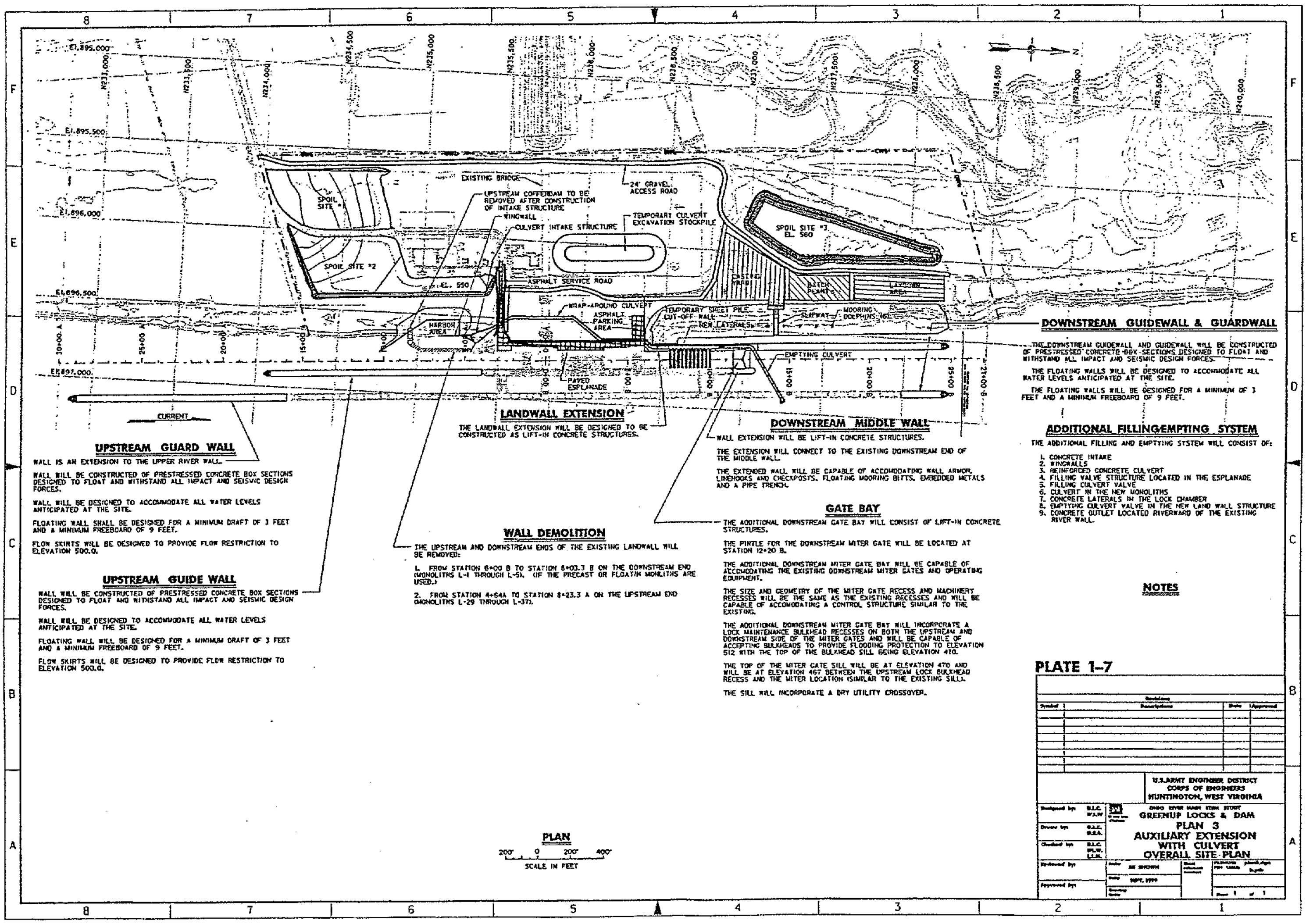
The purpose of extending the existing 600 foot lock to 1,200 feet is so that the existing 1,200-foot lock can be shut down for an extended maintenance/rehabilitation period without impacting lockage times (splitting tows to pass the 600-foot lock) on the river. Or operational procedures could be modified at that time designating riverward lock upbound only, landward lock downbound only, mitigating the need for full length guard/guidewall extensions upstream/downstream on both locks.

Wall extensions are compounded since extending the upper middle wall (UMW) dictates that the upper river wall (URW) be extended an additional 1,200 feet to provide a lay-up area for the riverward lock. Extending these walls (UMW, URW, LLW, and LRW) to a full length of 1,200 feet is probably not necessary, but is shown that way in the current plan because guidance recommends that guide/ guard walls be as long as the lock chamber. This is a rule of thumb and is guidance only, not a requirement. In reality walls can be significantly shorter. Wall lengths should be designed by several physical models to consider not only a navigation model, but also a debris/ice model, since accumulation and removal of debris/ice will be severely affected by extension of the existing wall systems. These wall extensions will trap more debris and ice which no longer can be removed by the current methods of removal. It should be noted that restriction in lock operation because of an increase in debris/maintenance removal time will reduce navigation times and offset gains anticipated or actually lose time overall. Wall extension impacts on navigation times must be carefully weighed between improving navigation times and reducing debris/ice maintenance costs and time losses. Any extensions should show overall improvement in existing operational conditions as well as navigation improvements.

Also note that extension of upstream middle wall and riverward guard wall creates a narrow trough which slows passage of the tow into/out of the lock chamber, since the toe now has to push against a longer constrained pool of water for both entry and exit. This slows passage and increases overall lockage time.

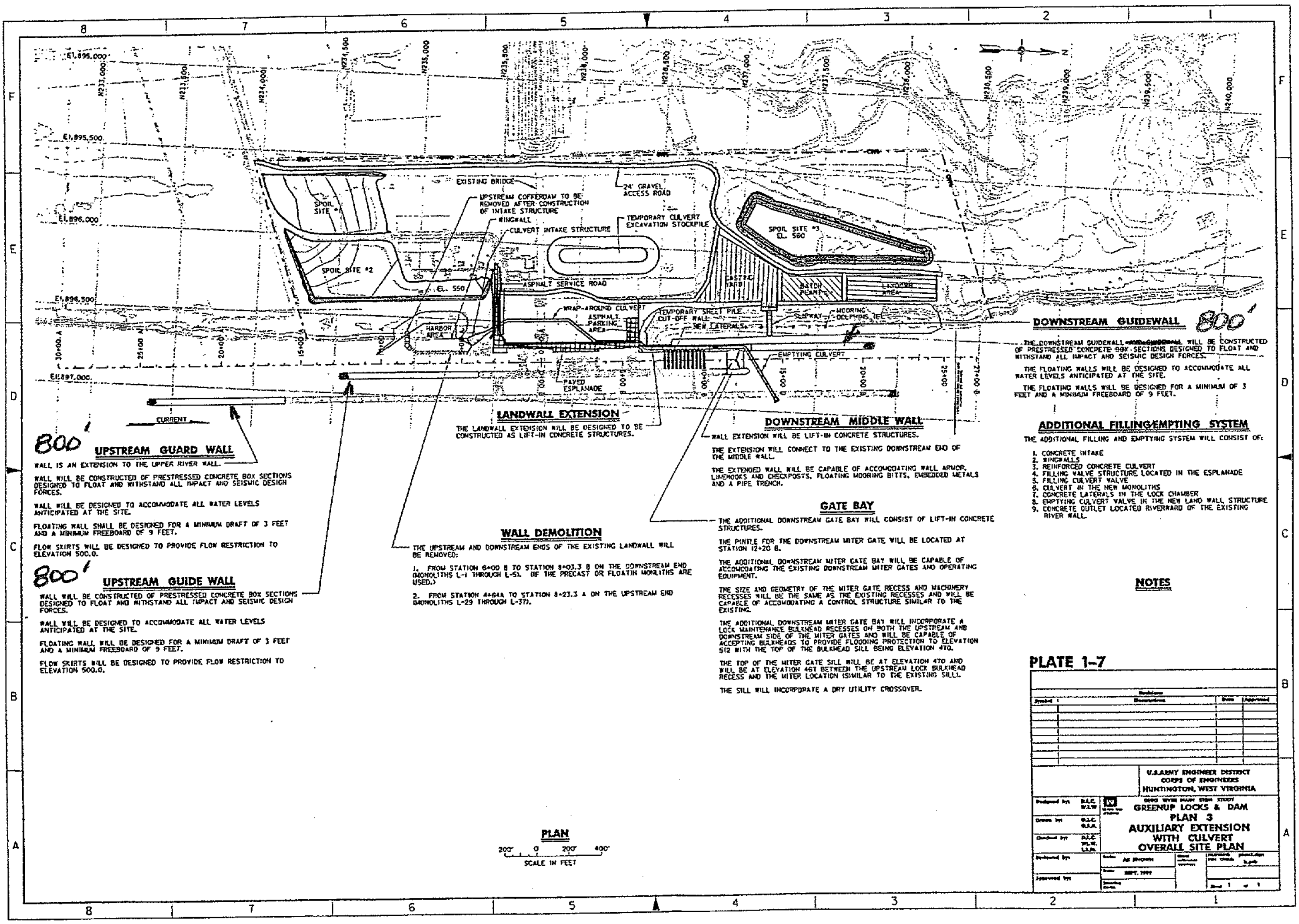
DRAWING NO 1:

ORIGINAL DESIGN



DRAWING NO 2:

PROPOSED DESIGN



VALUE ENGINEERING PROPOSAL

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO: C-2 Reduce Lengths of All Approach Wall Extensions				PAGE 5 OF 5
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Reduce approach wall extensions to 800 feet:				
	Upstream middle floating wall (UMW)	LF	400	$7,215	$2,886,000
	Upstream river floating wall (URW)	LF	400	$6,739	$2,695,600
	Downstream landside floating wall (LLW)	LF	400	$6,642	$2,656,800
	Downstream riverside floating wall (LRW)	LF	249	$8,863	$2,206,887
	Nose pier	EA	1	$3,583,561	$3,583,561
					$0
					$0
					$0
					$0
					$0
					$0
			Total Deletions		$14,028,848
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Additions		$0
			Net Cost Decrease		$14,028,848
		*	Mark-ups	0.00%	$0
			Total Cost Decrease		$14,028,848
*	Unit prices contain mark-ups for OH&P, and escalation & contingency				

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-3 PAGE NO: 1 OF 3

DESCRIPTION: Eliminate Filling System

ORIGINAL DESIGN:

The original design proposes constructing an intake structure, a "wrap around" culvert and a lateral manifold field to distribute flow in the lower end of the chamber during filling.

PROPOSED DESIGN:

The proposed design eliminates the filling culvert and tainter valve. (See Drawing No. 1).

ADVANTAGES:

1. Reduction in construction effort associated with the intake structure, "wrap around" culvert, and a reverse tainter valve.
2. Significant reduction to project cost.

DISADVANTAGES:

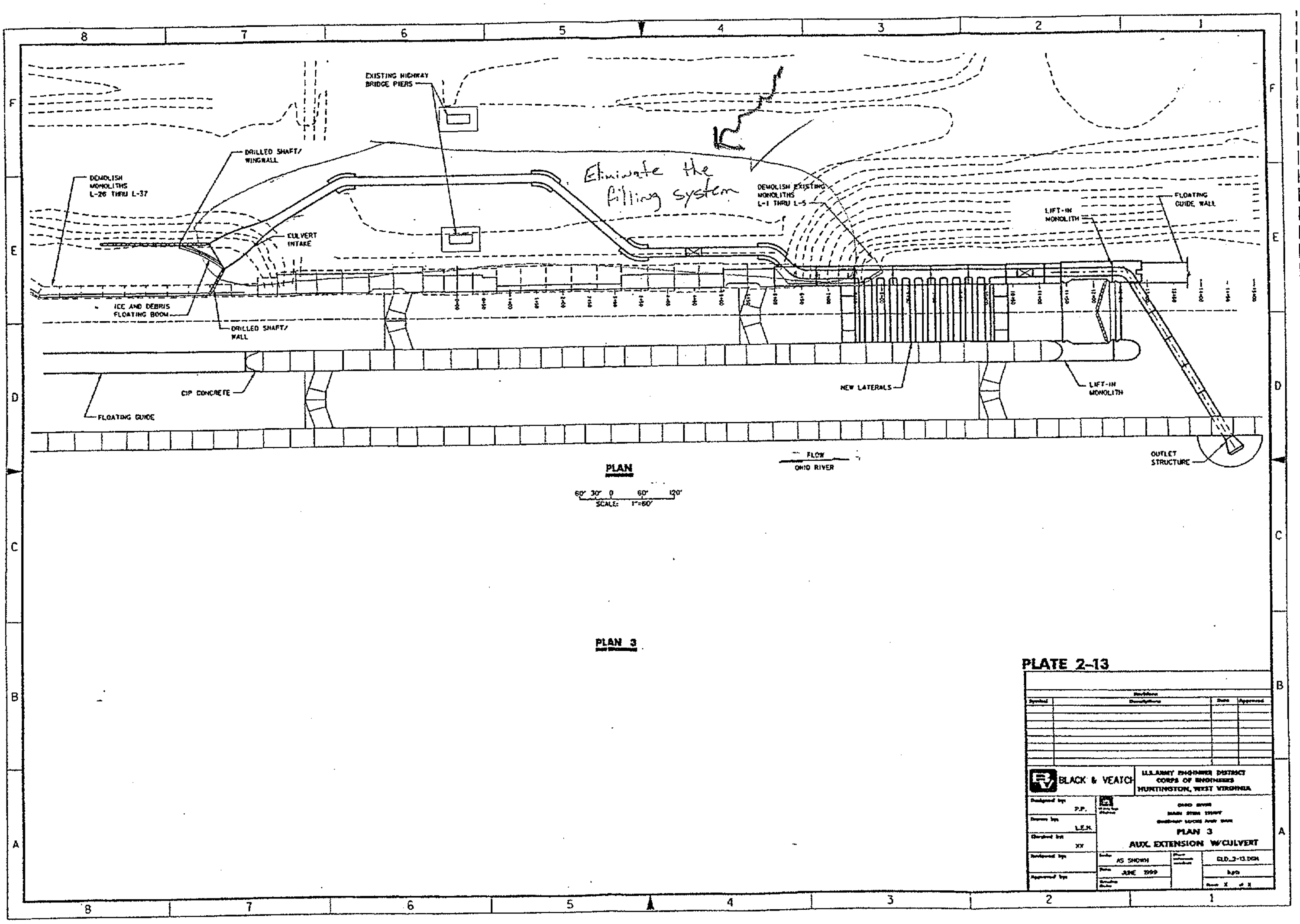
1. The extended lock chamber would require a longer filling time because using the culvert system designed for 600-foot lock to fill a 1200-foot chamber. There is also a potential that a moored tow could be subjected to unsafe conditions during filling. There is a risk that a longitudinal seiche could be established when filling from only one end of the 1200-foot chamber.

JUSTIFICATION:

The cost savings of not constructing a filling system is approximately $18,000,000. However, this design results in loss of benefits with the increased filling time. The feasibility report indicates that the filling time with the original system is about 10 minutes using a 6-minute valve time, and that the proposed system (no supplemental filling system) takes about 16 minutes to fill using a 6-minute valve. So, another operational cost associated with this proposal is an additional 6-minute filling time.

DRAWING NO. 1

PROPOSED DESIGN WOULD ELIMINATE FILLING SYSTEM



COST ESTIMATE WORKSHEET				
PROPOSAL NO.: C-3 Eliminate Filling System				PAGE 3 OF 3
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Filling system (Plan 3-Plan 2)	LS	1	$18,000,000	$18,000,000
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$18,000,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$0
		Net Savings		$18,000,000
		Mark-ups		$0
		Total Savings		$18,000,000
Assume eroded area is at a depth -5'				
Training dike: 1 slope from -5' to +2' with 2' crown				
#1 stone				

PROPOSAL NO: C-4

DESCRIPTION: Use a Siphon versus Deep Gravity Culvert Filling System

ORIGINAL DESIGN:

The new filling culvert is routed around the existing landwall and between the existing bridge piers at invert elevations varying from 483 feet near the intake to 463 feet at the culvert filling valve. This culvert consists of 15.5-foot high by 16-foot wide inside-dimension concrete box culvert. This requires excavation depths to a maximum of 60 feet in depth and shoring for approximately 950 feet to the filling valve box.

PROPOSED DESIGN:

The siphon-culvert would develop following the inflow from the original design intake structure. It would utilize two 12-foot diameter steel pressure pipe lines meeting the intake at depth, then running just beneath the surface, then meeting the culvert valve at depth.

ADVANTAGES:

1. Eliminates significant excavation, dewatering and backfill.
2. Substantial reduction to project costs.
3. Technology is available for this application.

DISADVANTAGES:

1. Not as hydraulically efficient as the original design.
2. May be a significant risk of losing the siphon between lockages resulting in lost time and higher operating costs for a mechanically dependent filling system.

JUSTIFICATION:

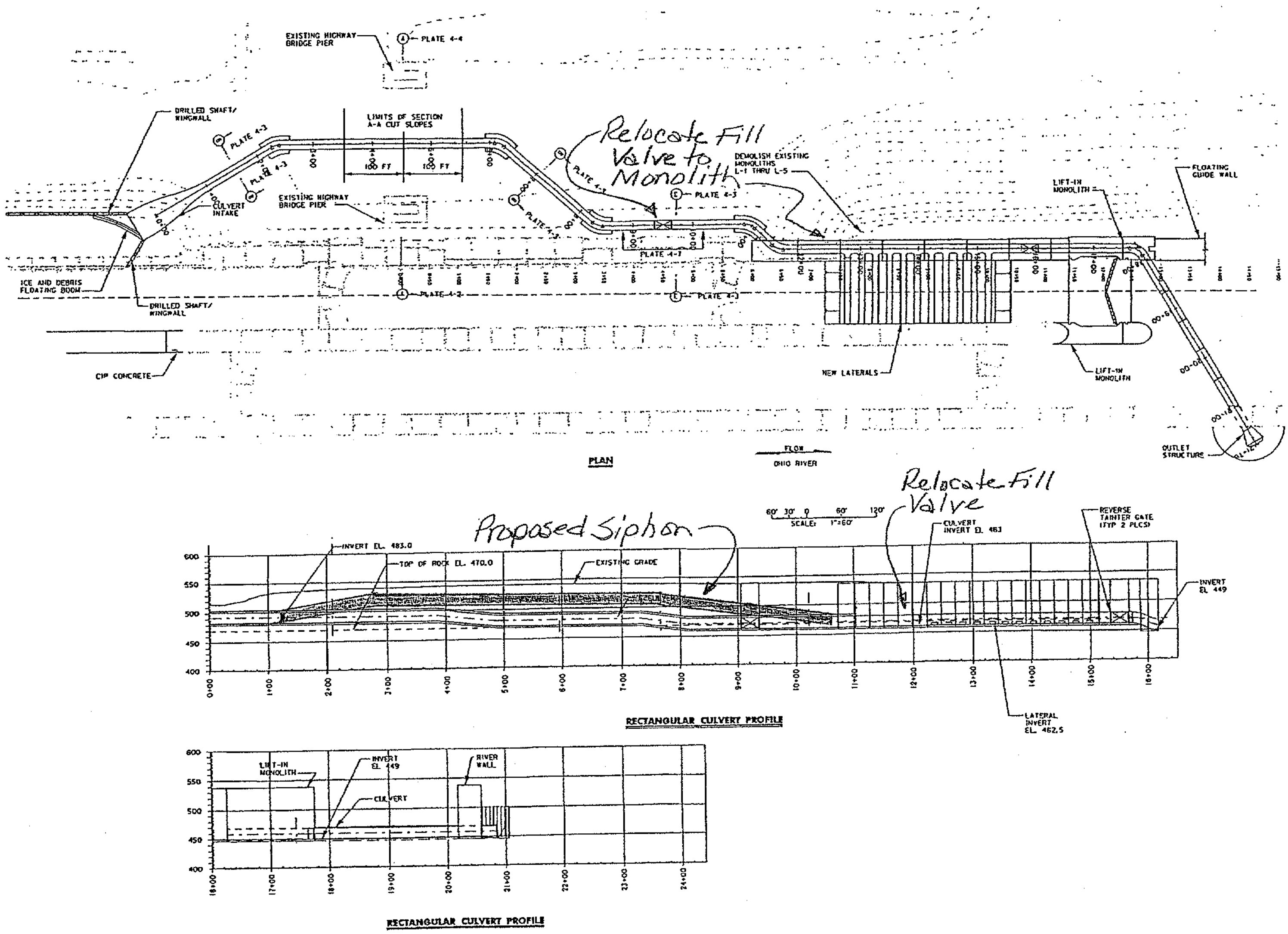
This proposal has potential provided that the loss of siphon operational concerns can be overcome. The proposal does include $500,000 to provide for vacuum pumps and piping to help maintain that siphon. No loss of filling time is achieved by this design. Additional O&M may jeopardize the nominal savings for the mechanical systems. Technical evaluation is warranted however. An existing application has not been identified for a lock operation, although large diameter siphons are widely used for other applications. Reliability and risk should be considered.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-4

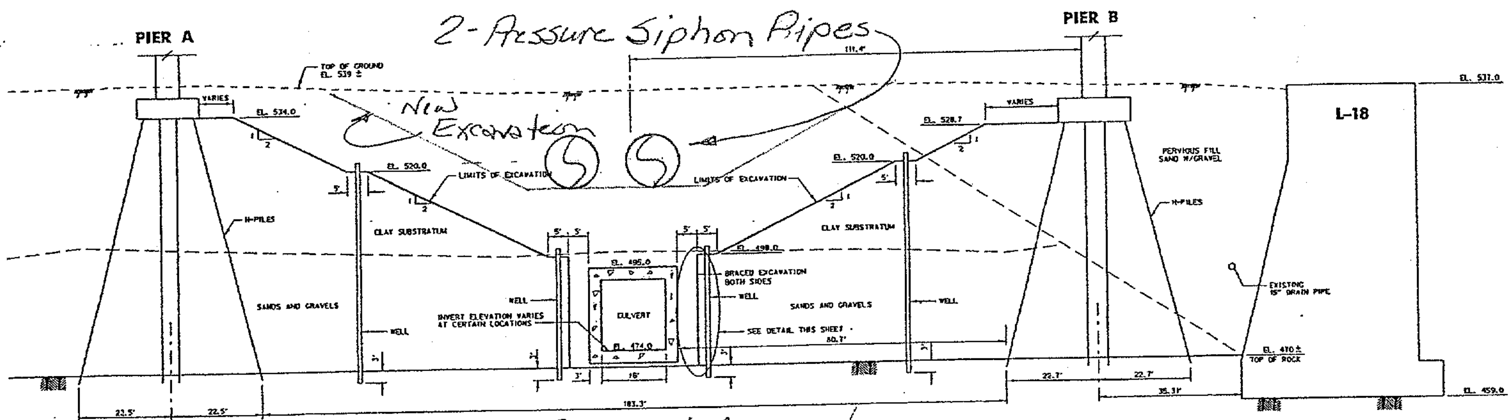
DRAWING NO. 1:

CURRENT GRAVITY BOX CULVERT AND PROPOSED SIPHON PROFILES



DRAWING NO. 2:

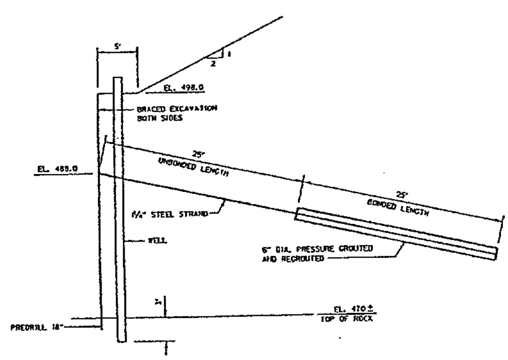
CURRENT GRAVITY BOX CULVERT AND PROPOSED SIPHON SECTIONS



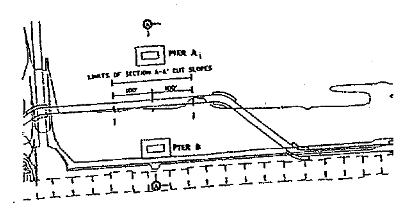
Current Culvert

SECTION A-A
SCALE: 1" = 20'

(Siphon Pipe Proposed



EXCAVATION SUPPORT
SCALE: 1" = 10'



PLAN

VALUE ENGINEERING PROPOSAL

COST ESTIMATE WORKSHEET

PROPOSAL NO: C-4 Use a Siphon vs. Deep Gravity Culvert Filling System				PAGE 4 OF 4

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Plan 3 Filling/Emptying System	LS	1	$22,993,680	$22,993,680
Plan 2 Emptying System (Remove Emptying)	LS	1	-$4,400,660	-$4,400,660
(Net cost for filling system results)				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$18,593,020

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
12' Diameter Pipe	LF	1,600	$3,900.00	$6,240,000
Vacuum Pump & Piping (Allowance)	LS	1	$500,000	$500,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$6,740,000
		Net Cost Decrease		$11,853,020
	*	Mark-ups	0.00%	$0
		Total Cost Decrease		$11,853,020

* Unit prices contain mark-ups for OH&P, and escalation & contingency

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-5

DESCRIPTION: Manifold Intake on Upstream Side Wall

ORIGINAL DESIGN:

Provide intake for supplemental wrap around culvert system with an intake behind existing land wall. The existing design calls for demolition of landwall monoliths L-29 through L-37. Drilled shaft wing walls and culvert intake are provided for in the original design.

PROPOSED DESIGN:

This proposal is tied to the proposal which would shorten or eliminate approach wall extensions. If they are shortened or eliminated (especially the upper middle wall extension) then this proposal has merit. This would require a manifold installed through the upstream guide wall.

ADVANTAGES:

1. Eliminates need for intake and wing wall construction.
2. Eliminates need for debris and ice boom.
3. No demolition of existing upstream guide wall needed if approach wall modifications are included.
4. Leaves area for work boat if existing guide wall are not altered.
5. Modified intake would be well upstream of existing auxiliary intake.

DISADVANTAGES:

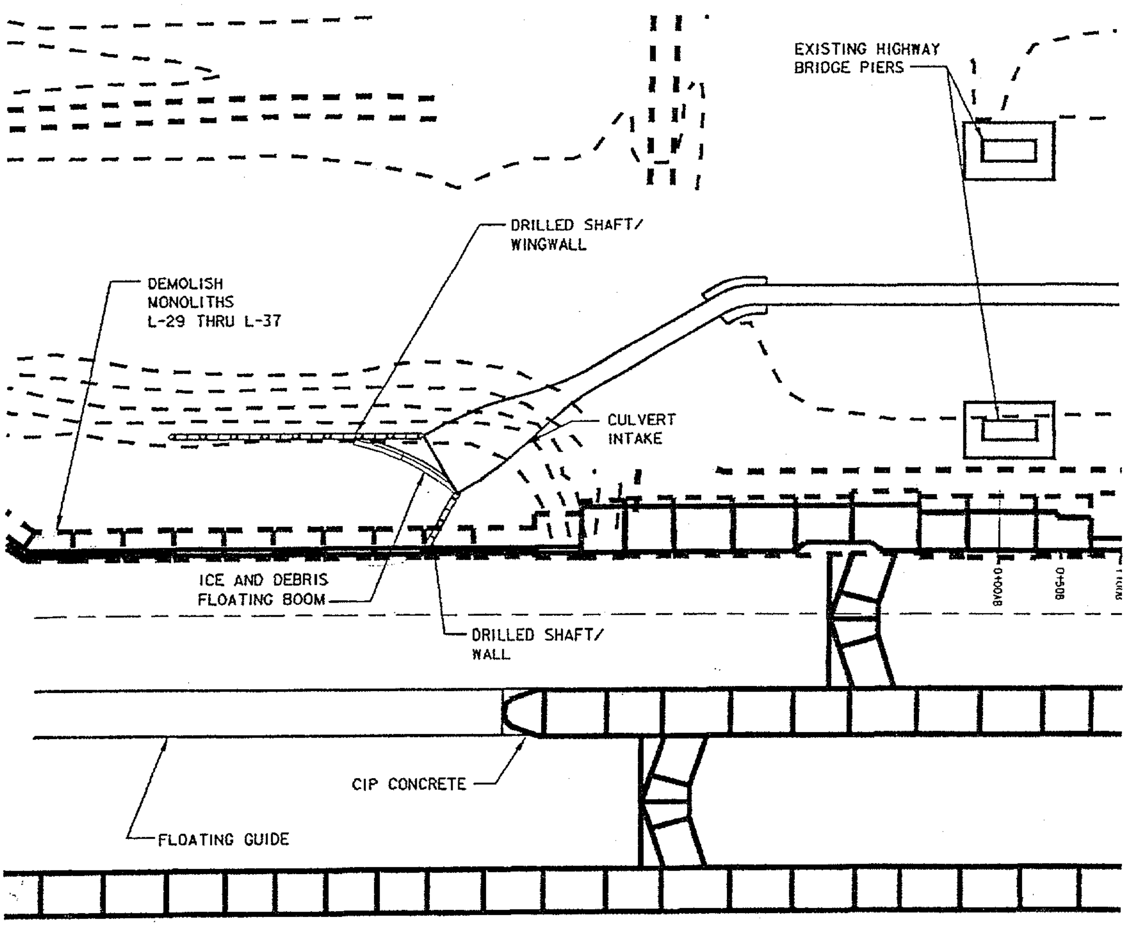
1. Would require hydraulic modeling to verify that it is acceptable.
2. Tied to elimination of shortening of upstream middle approach wall extension.

JUSTIFICATION:

This proposal has the potential to lessen construction costs if it is hydraulically feasible. Certain precautions could be taken to reduce any potential vortexes. This option should be investigated if the approach wall configuration changes as part of other proposals.

DRAWING NO. 1

EXISTING DESIGN WITH DEMOLITION OF I-29 THROUGH L-37 AND NEW WING WALLS

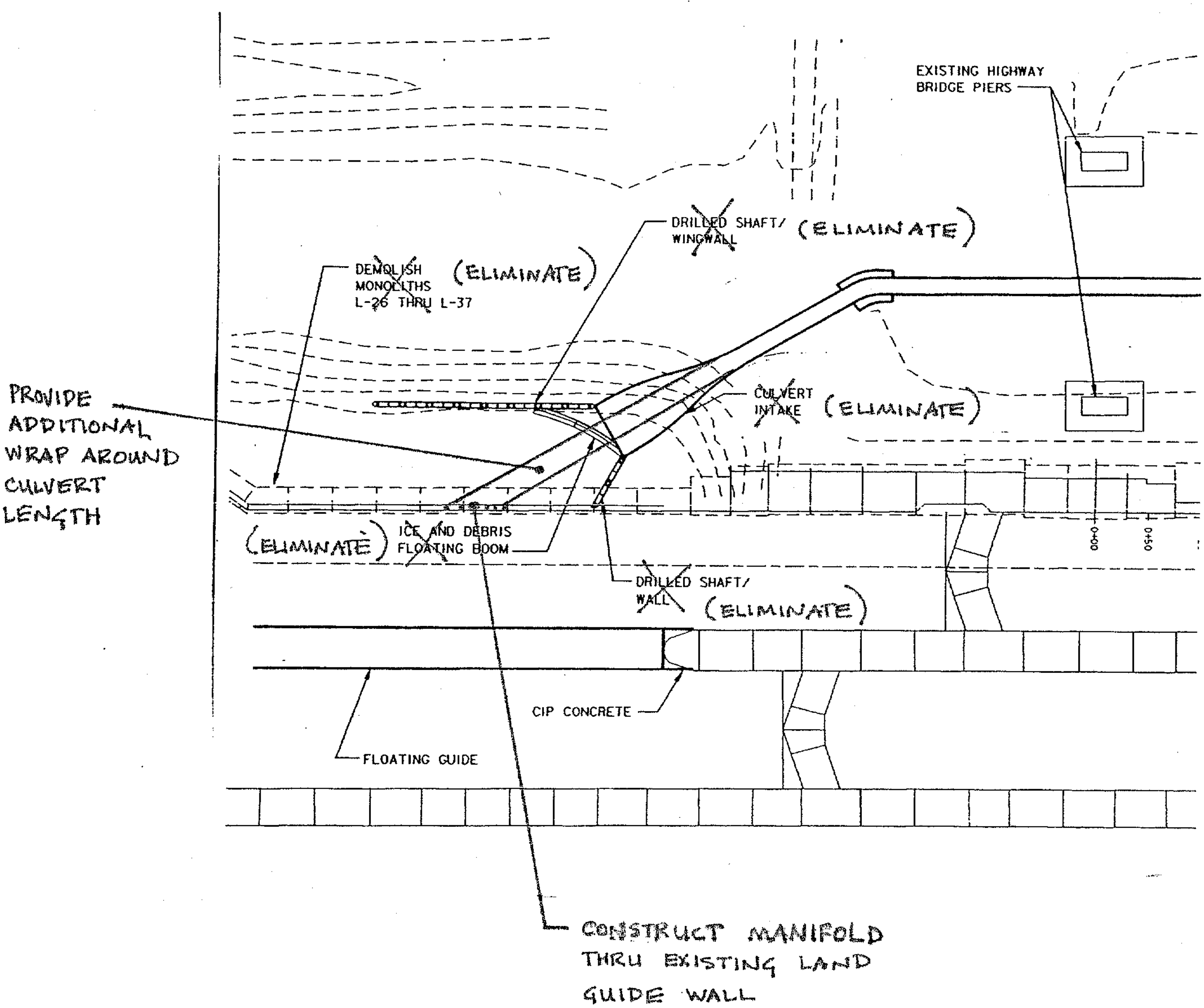


EXISTING DESIGN

- CALLS FOR WING WALLS AND DRILLED SHAFT WALLS AS SHOWN WITH ICE/DEBRIS BOOM
- DEMOLITION OF MONOLITHS AT L29 – L37 ARE REQUIRED TO SHORTEN THE PROPOSED APPROACH WALL EXTENSION LENGTHS, WHICH REDUCES OVERALL PROJECT COST.

DRAWING NO. 2

PROPOSED DESIGN WITH MANIFOLD THROUGH LAND GUIDE WALL



COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-5 Manifold Intake on Upstream Side Wall

PAGE 4 OF 4

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Ice/debris boom	LS	1	$1,230,870	$1,230,870
Intake structure and wingwalls	LS	1	$2,475,750	$2,475,750
No demolition of L-29 thru L-37	CY	11,505	$91.04	$1,047,415
				$0
				$0
				$0
		Total Deletions		$4,754,035

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Additional wrap-around culvert	LF	250	$3,400.00	$850,000
Wire cutting for inlet	SF	625	$110.00	$68,750
Concrete removal	CY	930	$91.04	$84,667
Reinforcing	LB	90,000	$0.75	$67,500
CIP concrete	CY	300	$220.00	$66,000
				$0
		Total Additions		$1,136,917
		Net Savings		$3,617,118
		Mark-ups	0.00%	$0
		Total Savings		$3,617,118

Use same rough cost per foot for JT Myers wrap around culvert

Used same concept quantities from JT Myers VE Study Estimate

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-6 PAGE NO: 1 OF 2

DESCRIPTION: Use Excavated Rock for Cell Fill Placement

ORIGINAL DESIGN:

The current design uses tremie and cast-in-place concrete for the monoliths. The estimated quantities are 48,100 cubic yards (CIP) and 31,050 cubic yards (tremie). 29,000 cubic yards of rock will be removed for the construction of the monoliths.

PROPOSED DESIGN:

This proposal recommends that the excavated rock be used for cell fill placement in the monoliths.

ADVANTAGES:

1. Reduces project cost.
2. Re-uses waste material.
3. Allows for weight in gravity structure.

DISADVANTAGES

1. Excavated rock may not be suitable for use in the monoliths.
2. An engineering analysis of the material and its use in the structure must be performed.

JUSTIFICATION:

This proposal will provide the same weight function in the massive gravity wall structure of the monolith as the current design at a reduced cost. This placement may be more suited to a float-in structure versus the lift-in structure. An engineering analysis must be performed on the rock material and determine where it could be used most effectively in the structure. Some savings would be lost due to performing this engineering analysis.

COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-6 Use Excavated Rock for Cell Fill Placement

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Tremie Concrete Fill	CY	29,000	$165.00	$4,785,000
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$4,785,000

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Rock Fill	CY	29,000	$4.50	$130,500
				$0
				$0
				$0
				$0
				$0
		Total Additions		$130,500
		Net Savings		$4,654,500
		Mark-ups	0.00%	$0
		Total Savings		$4,654,500

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-7 PAGE NO: 1 OF 4

DESCRIPTION: Place F/E System for Extension Landside Lockwall and Bridge Pier

ORIGINAL DESIGN:

The conduit alignment is routed approximately 150 feet landward of the lockwall and passes between two existing bridge piers. After the conduit passes under the bridge, the alignment returns to a location adjacent the lockwall.

PROPOSED DESIGN:

The horizontal alignment of the conduit is adjacent to the lockwall along the entire length. The vertical alignment rises from the intake structure to an elevation needed to pass the bridge pier without interfering with the pile supports for the bridge pier. Change to circular section for conduit.

ADVANTAGES:

1. Decreases total length of conduit.
2. Decreases excavation and backfilling.
3. Decreases head losses by eliminating length of pipe and some elbows.
4. Additional savings and hydraulic efficiency can be achieved by placing the distribution manifold behind the lock wall. This eliminates conduit bends and thrust blocks.

DISADVANTAGES:

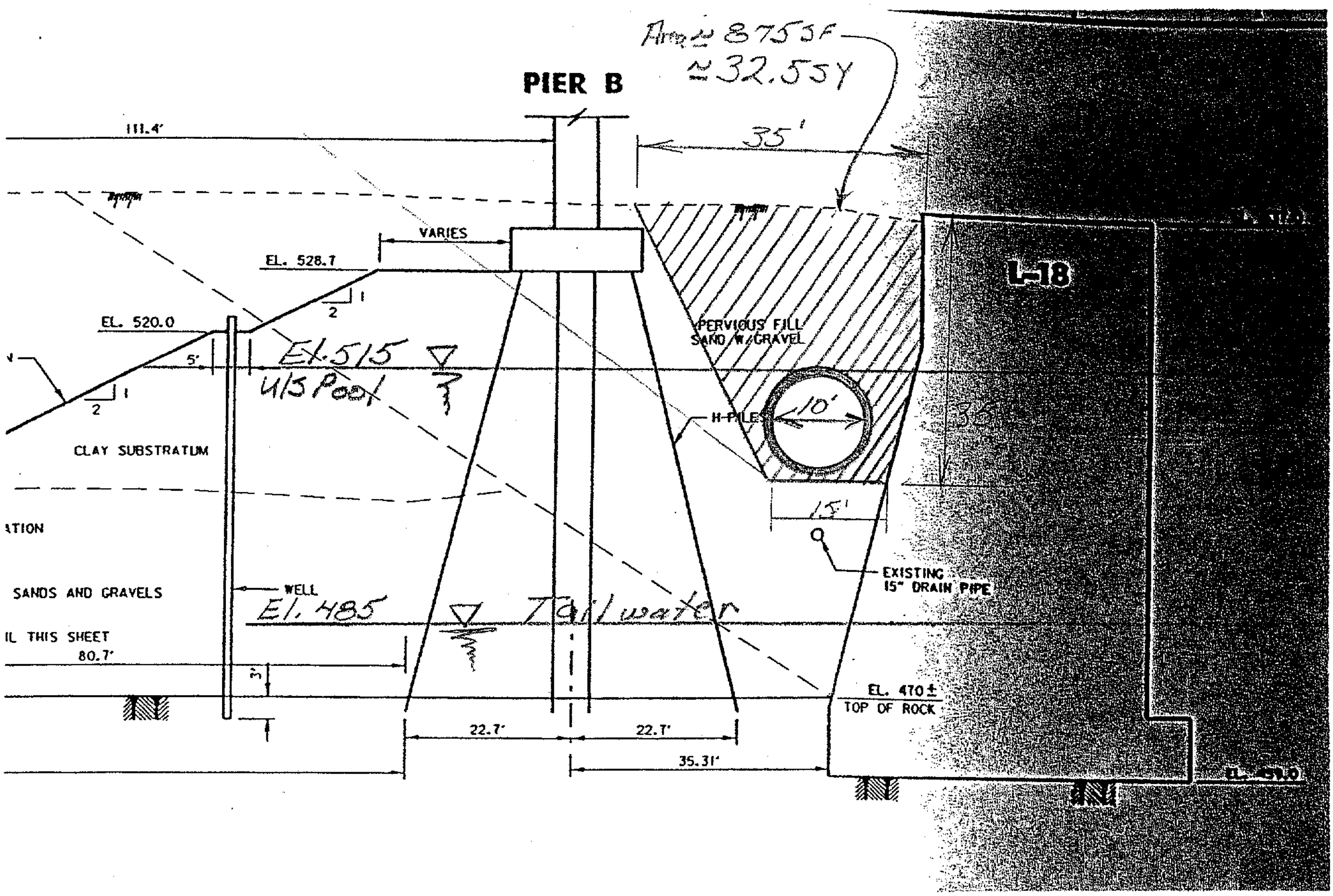
1. Tight working conditions in vicinity of bridge pier.
2. Pipe needs to rise from inlet to bridge pier in order to avoid interference with bridge pier piling.

JUSTIFICATION:

This proposal has potential cost savings of approximately $2,590,740. This configuration is also much more hydraulically efficient than the current proposal.

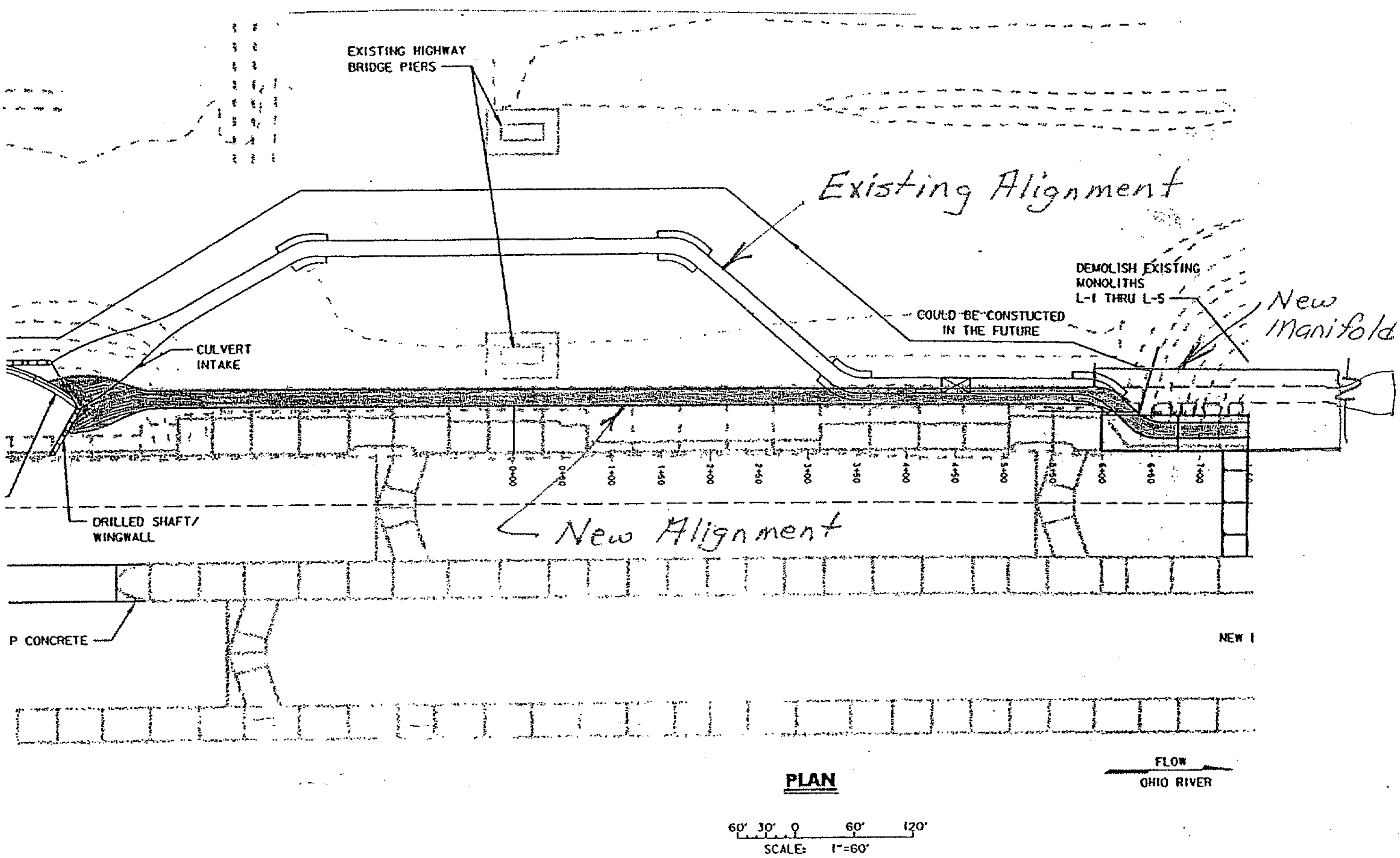
DRAWING NO. 1

PROPOSED DESIGN WITH CONDUIT BEHIND LOCKWALL



DRAWING NO. 2

PROPOSED DESIGN WITH NEW CONDUIT ALIGNMENT



COST ESTIMATE WORKSHEET				
PROPOSAL NO.: C-7 Place F/E System for Extension Landside Lockwall				PAGE 4 OF 4
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
64.100 shoring for excavation	LS	1	$443,760.00	$443,760
64.271 excavate dry earth & haul	LS	1	$3,280,260.00	$3,280,260
200 ' of pipe length	CY	590	$540.00	$318,600
64.842 thrust blocks	EA	2	$125,000.00	$250,000
				$0
				$0
		Total Deletions		$4,292,620
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Excavation dry earth & fill	CY	157,947	$9.37	$1,479,963
Shoring (assume 1/2 of original)	LS	1	$221,880.00	$221,880
				$0
				$0
				$0
				$0
		Total Additions		$1,701,843
		Net Savings		$2,590,777
		Mark-ups	0.00%	$0
		Total Savings		$2,590,777

DESCRIPTION: Drilled Shaft Wall (Anchored)

ORIGINAL DESIGN:

Construct the landwall with lift-in towers and precast panels.

PROPOSED DESIGN:

Construct the landwall with drilled shafts, tie back anchors and precast panels. The space between the shafts is closed by placing precast "H" panels. The culvert must pass behind the wall.

ADVANTAGES:

1. Significant material reduction.
2. Heavy lifts are reduced.

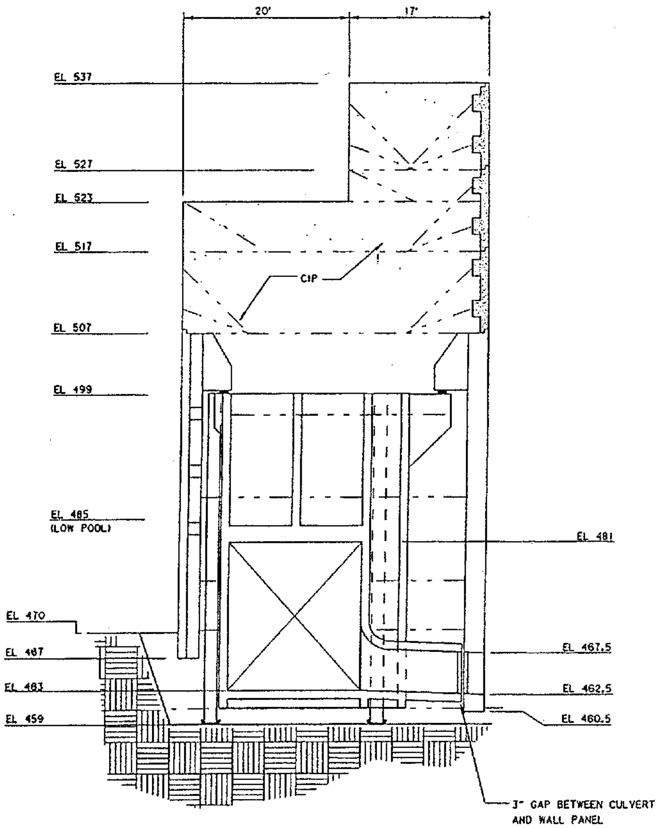
DISADVANTAGES:

1. Requires large shaft drilling equipment.
2. Exposed portion of anchors interferes with future use of the area behind the landwall. It will also be fouled with debris and trash.
3. Fill may be required behind the landwall to ensure the maintenance condition is the controlling load case.
4. Additional rock spoil is created.
5. Additional reinforcement is required.
6. May not be technically feasible due to rock deflection.

JUSTIFICATION:

There is a significant savings in concrete when this wall section is adopted. Load on the rock must be carefully considered. Rock strength and P-Y curves could be refined by full-scale testing.

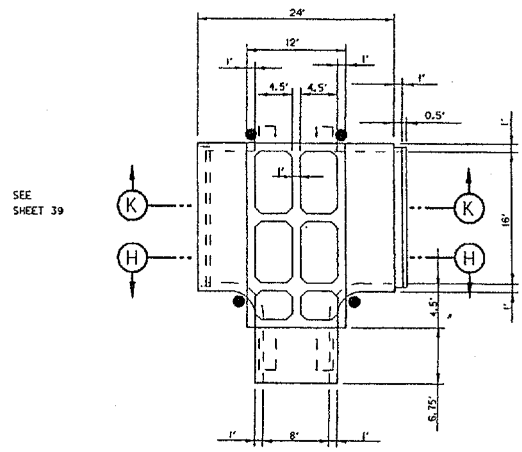
DRAWING NO. 1



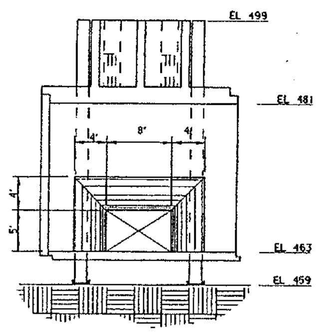
NOTES:

1. FIRST LIFT TREMIE SHALL NOT BE MORE THAN 8 FT IN ORDER TO OVERCOME BUOYANCE.
2. REMAINING LIFTS SHALL BE BY INCREASING ELEVATION, BUT NOT MORE THAN 10 FT EACH.
3. PROVIDE TEMPORARY BRACING INSIDE CULVERT DURING CONSTRUCTION.
4. PROVIDE KNOCKOUT PANELS AT THE END OF THE CULVERT OUTLET TO THE LATERAL, AND IN THE WALL PANEL. REMOVE KNOCKOUTS AND 3" GAP AFTER TREMIE HAS SET.

SECTION M-M (FROM PLATE 2-16)



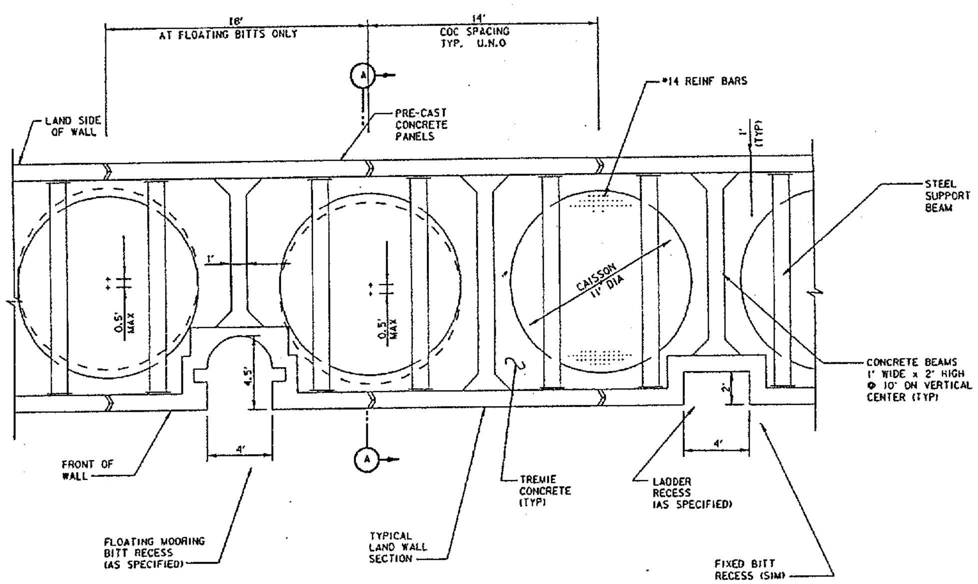
PLAN



ELEVATION

SECTION H-H

DRAWING NO. 2

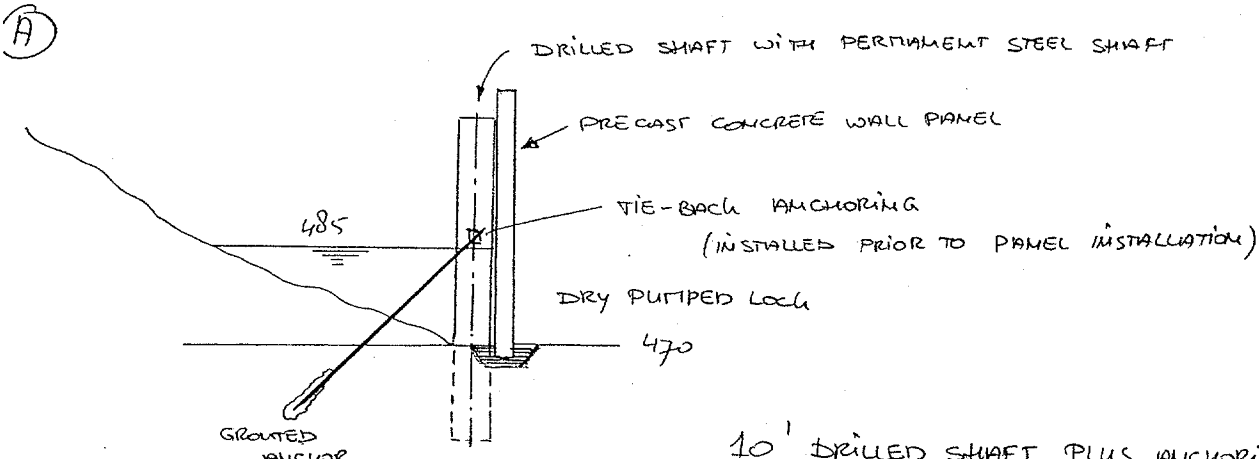


NOTE:
TOP OF CAISSON @ EL 500'
CAST-IN-PLACE CONCRETE FROM EL 500' TO EL 537'.

DRILLED CAISSON PLAN

ALTERNATIVES FOR "FAILED" DRILLED CAISSON LOCK WALL

(A)



10' DRILLED SHAFT PLUS ANCHORING

CALCULATIONS

Calculate material savings

Assume 17' width

Section Area new = $17 \times 78 = 1326\ ft^2$

" " Exist$_g$ = $17 \times 78 + 20 \times 64 = 2606\ ft^2$

$1280\ ft^2$

Volume saved = $1280' \times 541'/27$ = ~~52,200~~ 25,650 cy
(Sta 11+41 - 6+00)

Add

Rock excavation $12'\ \phi \times 20'$

$= \frac{12^2}{4} \pi \times \frac{20}{27} = 84$ cy/shaft

Vol 12 shafts = 12×84 = 1000 cy Excavation

Assume similar height to exstg for reinf

Vol reinf concrete = $\frac{12^2}{4} \pi \times \frac{98}{27} = 410$ cy

for ~~200~~ 170 lb/cy Reinf = $170 \times 410 \times 12$ = 420 tons reinf

Anchors required 2/shaft

$12 \times 2 = 24$ anchors

Culvert $19 \times 17 - 18 \times 16 = 35\ ft^2$

Vol $35 \times \frac{541}{27} = \frac{19\,000}{27}$ cy = 701 cy

COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-8 Drilled Shaft Wall (Anchored)

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete (lift-in and tremie)	CY	25,650	$250.00	$6,412,500
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$6,412,500

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Rock excavation	CY	1000	$852.00	$852,000
Reinforcing	TON	420	$1,300.00	$546,000
Rock anchor	EA	24	$22,500.00	$540,000
Culvert	CY	700	$500.00	$350,000
Tremie Concrete	CY	1000	$165.00	$165,000
Culvert				$0
		Total Additions		$2,453,000
		Net Savings		$3,959,500
		Mark-ups	0.00%	$0
		Total Savings		$3,959,500

PROPOSAL NO: C-9

DESCRIPTION: Drilled Shaft Landwall (Doubled)

ORIGINAL DESIGN:

Construct the landwall with lift-in towers and wall panels.

PROPOSED DESIGN:

Construct a bent with two 4-foot drilled shafts to resist unbalanced load. Install the culvert between the rows of 4-foot shafts.

ADVANTAGES:

1. Less concrete.
2. Precast elements are less complex.

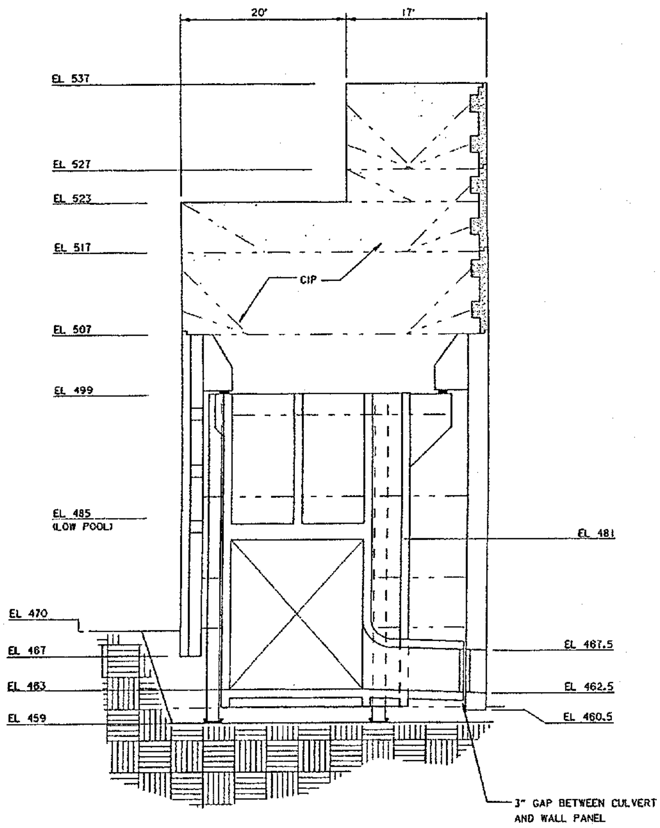
DISADVANTAGES:

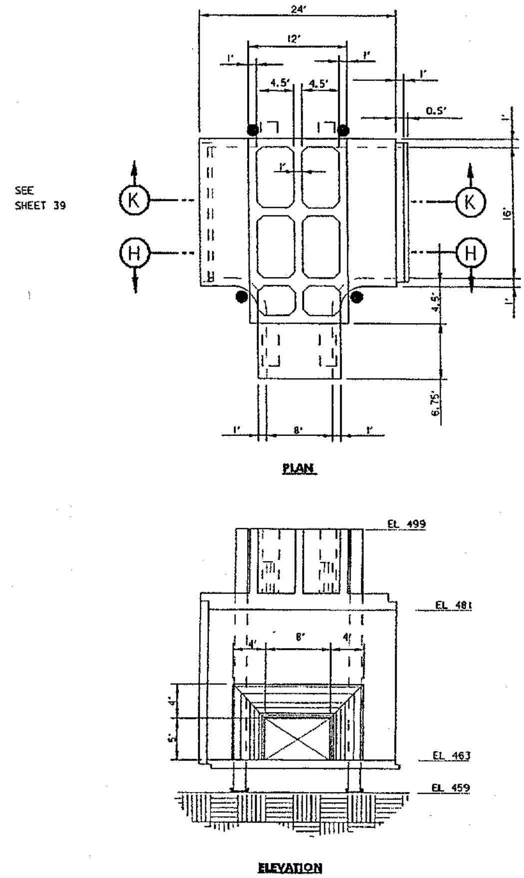
1. More rock excavation.
2. More reinforcing.

JUSTIFICATION:

Material is saved and a chamber is created that permits construction of the culvert in the dry. Load is taken into the rock in a more reliable tension compression couple. The 4-foot shafts will be drilled with conventional pier drill rigs.

DRAWING NO. 1





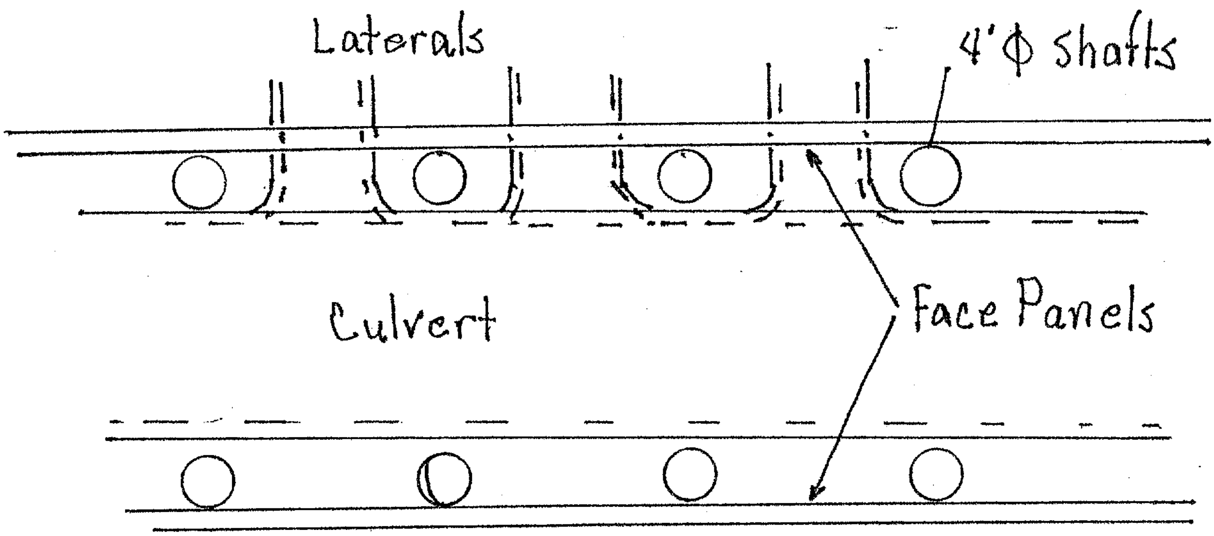
SECTION H-H

NOTES:

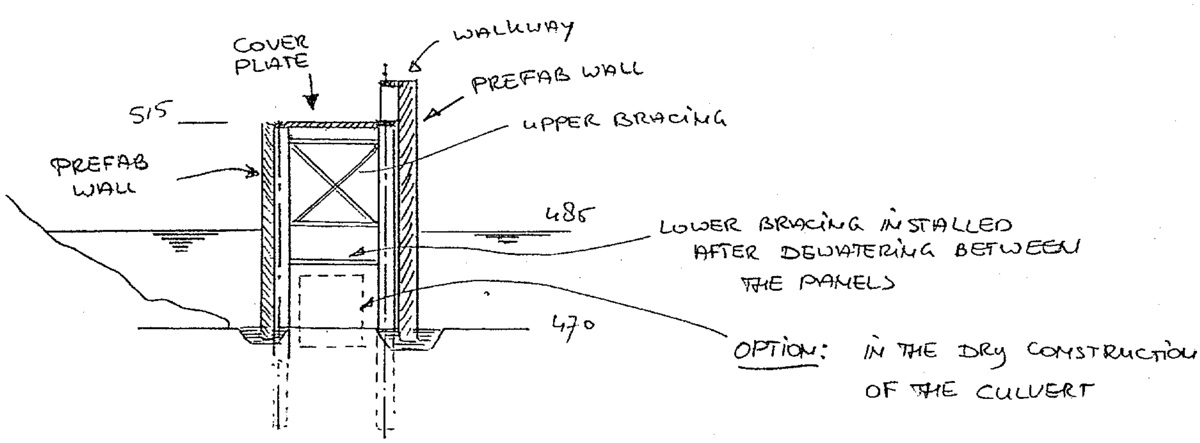
1. FIRST LIFT TREMIE SHALL NOT BE MORE THAN 8 FT IN ORDER TO OVERCOME BUOYANCE.
2. REMAINING LIFTS SHALL BE BY INCREASING ELEVATION, BUT NOT MORE THAN 10 FT EACH.
3. PROVIDE TEMPORARY BRACING INSIDE CULVERT DURING CONSTRUCTION.
4. PROVIDE KNOCKOUT PANELS AT THE END OF THE CULVERT OUTLET TO THE LATERAL, AND IN THE WALL PANEL. REMOVE KNOCKOUTS AND 3" GAP AFTER TREMIE HAS SET.

SECTION M-M (FROM PLATE 2-16)

DRAWING NO. 2

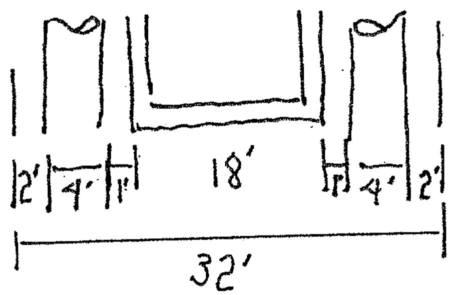


PLAN



BRACED PAIR SMALL DRILLED SHAFTS

Assume new section is 32' wide



Reduction

$(37-32)(64)\frac{(541)}{27} = 6400$ cy

Addition

Rock Excavation $\frac{4^2}{4}\pi \times \frac{20'}{27} \times 24 \times 2 = 450$ cy

Reinf $\frac{4^2}{4}\pi \times \frac{98}{27} \times 170\frac{lb}{cy} \times \frac{24 \times 2}{2000} = 186$ ton

Tremie Concrete $= 450$ cy

COST ESTIMATE WORKSHEET				
PROPOSAL NO.: C-9 Drilled Shaft Landwall (Doubled)				PAGE 5 OF 5
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete	CY	6,400	$250.00	$1,600,000
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$1,600,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Rock excavation	CY	450	$852.00	$383,400
Reinforcing	TON	186	$1,300.00	$241,800
Tremie concrete	CY	450	$165.00	$74,250
				$0
				$0
				$0
		Total Additions		$699,450
		Net Savings		$900,550
		Mark-ups	0.00%	$0
		Total Savings		$900,550

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-10 PAGE NO: 1 OF 6

DESCRIPTION: Eliminate Crossover Discharge, Route Behind Landside Guidewall

ORIGINAL DESIGN:

The emptying conduit crosses over both lock chamber approaches and discharges into the river.

PROPOSED DESIGN:

The emptying conduit is routed to discharge on the landward side of the floating guide wall. This outlet wall diffuser will be in the monolith directly downstream of the miter gate.

ADVANTAGES:

1. Elimination of underwater rock excavation directly adjacent to active commercial traffic.
2. Discharge water will flow along and under the floating guide wall. This will flush silt and debris away from guide wall and approach area.

DISADVANTAGES:

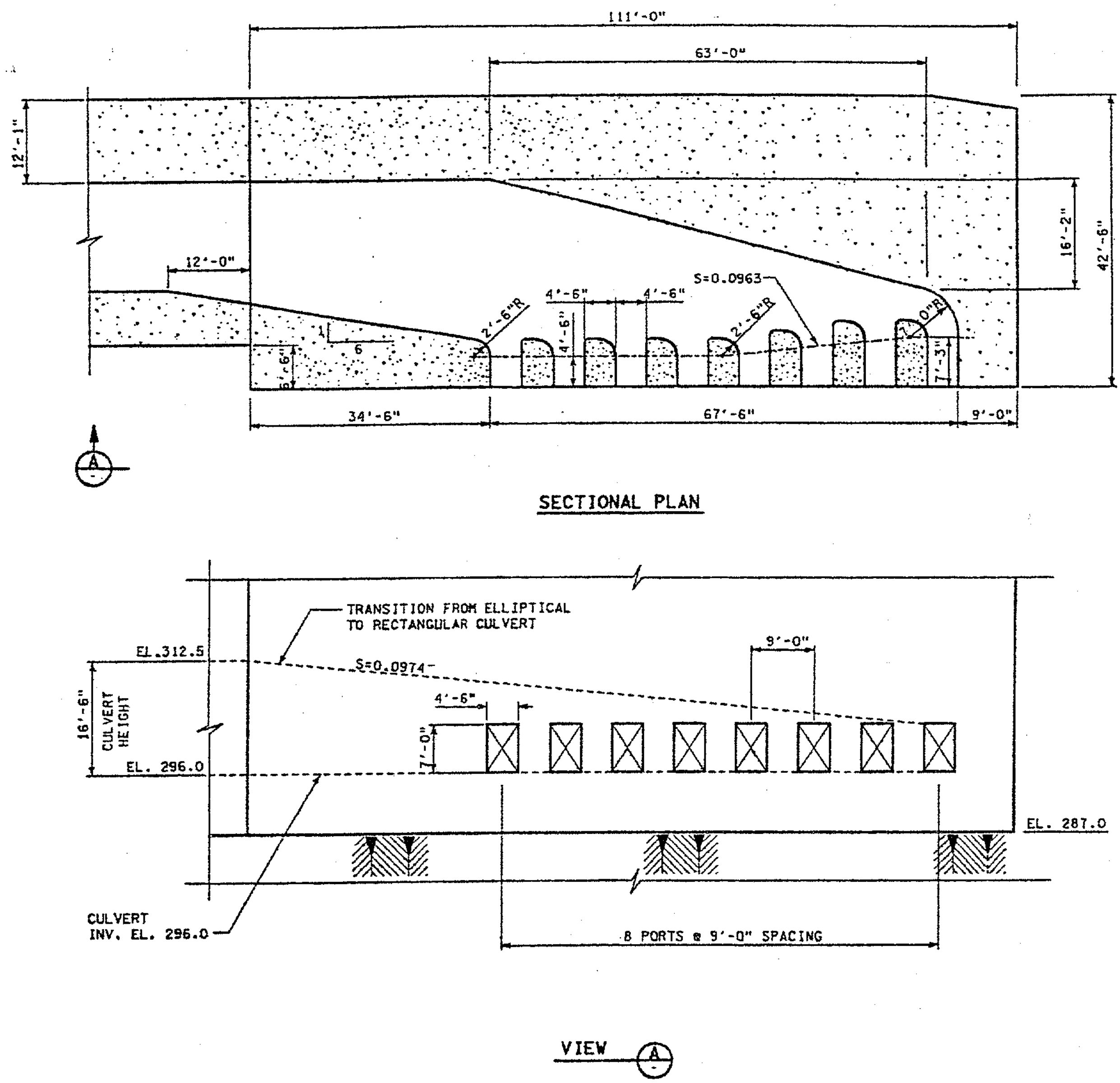
1. Possible turbulence in downstream approach area. Currently being model-studied for JT Myers.

JUSTIFICATION:

This proposal has a potential cost savings of approximately $2,750,000

DRAWING NO. 1

PROPOSED DESIGN OF OUTLET WALL DIFFUSER
(JT MYERS)

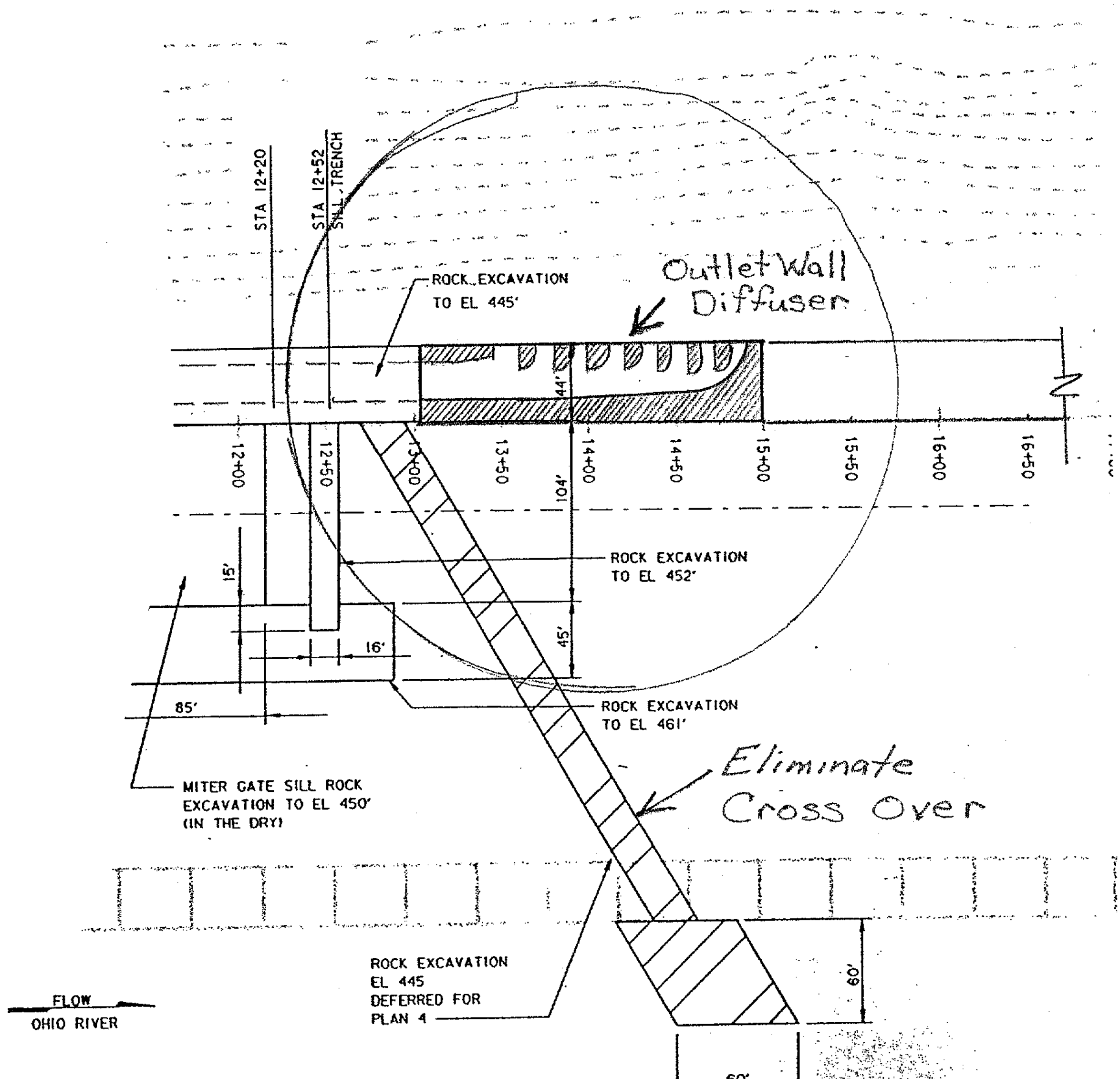


600' LOCK EXTENSION
OUTLET WALL DIFFUSER
SCALE: 1"=10'

Drawing taken from J.T. Myers and is
Shown opposite hand configuration

DRAWING NO. 2

PROPOSED DESIGN SHOWING CROSSOVER TO BE ELIMINATED



EXCAVATION PLAN
ALTERNATES 2,3,4

CALCULATIONS

USING LIFT-IN FOR DIFFUSER

GREENUP QUANTITY FOR DIFFUSER

	GREENUP	J.T. MYERS
TOP OF LOCK WALL	537.0	362.0
BASE OF DIFFUSER	459.0	287.0
LOWER POOL EL.	485.0	324.0

DIFFUSER SIZE

OVERALL HEIGHT = 78'
WIDTH = 42'
PRECAST / TREMIE HEIGHT = 30'
(ASSUMES 4' OVER L.P.)

CAST-IN PLACE HEIGHT = 48'

DIFFUSER SIZE (J.T. MYERS)

HEIGHT 75'
WIDTH 42'

PRECAST / TREMIE HEIGHT = 41'

CAST-IN-PLACE HEIGHT = 34'

GREENUP PRECAST VOLUME

AREA BELOW OPENINGS = (1')(42')(111') = 4662 ft³

SIDE SHELLS = (1')(29')(84' + 2(111)) = 8874 ft³

SHELLS AROUND OPENING = (8 OPENINGS)(1')(14'x2 + 8'x2)(6' AVG LENGTH)
= 2112 ft³

SHELL AROUND CULVERT = (1')(2'x35' + 65')(12' AVG HEIGHT) = 1620 ft³

PRECAST VOLUME = 4462 + 8874 + 2112 + 1620 = 17,068 ft³ → 633 CY

TOTAL VOLUME BELOW TREMIE LINE (EL. 489.0) = (111')(489 - 459')(42') - (8 OPENINGS)(8'x12')(6')
- (12' HEIGHT)(16' WIDE)(35' + 65') = 116,052 ft³
→ 4299 CY

TOTAL VOLUME ABOVE EL. 489 (CIP CONCRETE) = (111')(42')(537.0 - 489.0) = 223,776 ft³
→ 8288 CY

GREENUP LIFT-IN DIFFUSER = (633 CY)($575/CY) — PRECAST
+ (4299 CY)($165/CY) — TREMIE
+ (8288 CY)($220/CY) — CIP

$2,896,670

CALCULATIONS

From Green up Est.

63 Lock Structure

⇒ Item 64.15 Outlet Structure - use full cost

$1,165,180

⇒ 64.291 Culvert, Rock Excavation - This is for total excavation. Estimate only for cross-over

length ≈ 300', width ≅ 25', depth ≈ 25'

$\text{Volume}_{\text{Trench}} \approx (300')(25')(25')(\frac{1}{27}) = 6944 \text{ CY}$

$\text{Volume}_{\text{outlet trench}} \cong (60')(60')(25')(\frac{1}{27}) = 3,333 \text{ CY}$

Total 10,277 CY

Assume ≈ 40% of Item total = (.4)(593,350) ≅ $237,340

⇒ 64.845 Pre cast, Conc. Outlet Culvert - use full cost

$822,110

⇒ Existing Lock wall Replaced by Diffuser monolith.

Assume that cost of diffuser monolith should be comparable to existing monolith that accomodates the crossover. Total Cost of monoliths is a wash.

COST ESTIMATE WORKSHEET

	PROPOSAL NO.: C-10 Eliminate Crossover Discharge, Route Behind Guidewall				PAGE 6 OF 6
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	64.15 outlet structure	CY	700	$2,413.59	$1,689,510
	64.845 precast concrete culvert	CY	900	$913.46	$822,110
	Culvert rock excavation	LS	1	$237,340.00	$237,340
					$0
					$0
					$0
			Total Deletions		$2,748,960
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Greenup lift-in diffuser				$0
	Precast	CY	633	$575.00	$363,975
	Tremie	CY	4,300	$165.00	$709,500
	Cast-in-place	CY	8,288	$220.00	$1,823,360
					$0
					$0
*			Total Additions		$0
			Net Savings		$2,748,960
			Mark-ups	0.00%	$0
			Total Savings		$2,748,960
*	Lockwall monolith for crossover = $2,896,860				

PROPOSAL NO: C-11
DESCRIPTION: Add Sluice Gate and Culvert to Empty Dry Dock

ORIGINAL DESIGN:

Place bulkheads on upstream end of chamber and de-water the chamber for dry dock. Planned floor elevation is 515.0 feet with 19 feet of sand fill and two pump wells with a perforated pipe drainage system. Sand is capped with 12-inches of concrete. An existing 10-foot by 5-foot sluice drains water from elevation 538.0 feet to 534.0 feet.

PROPOSED DESIGN:

Utilize the existing sluice gate and put a sump directly below. Lower the floor elevation to the bottom of the chamber elevation 495.0 feet. Install 20-inch pumps at the lower end. Build the floor of the dry dock with weep holes. Use heavy aggregate under the concrete for drainage. Eliminate perforated pipe, filter cloth, and dowels. Add sluice gates in the bottom bulkhead for re-watering.

ADVANTAGES:

1. Increases the ability to water up and down. Faster with less labor.
2. Saves money on fill material, drainage pipe and filter cloth.
3. Increases the working height of a closed structure by approximately 19 feet. For example, the structure could be used to paint and sandblast miter gates in their upright position.

DISADVANTAGES:

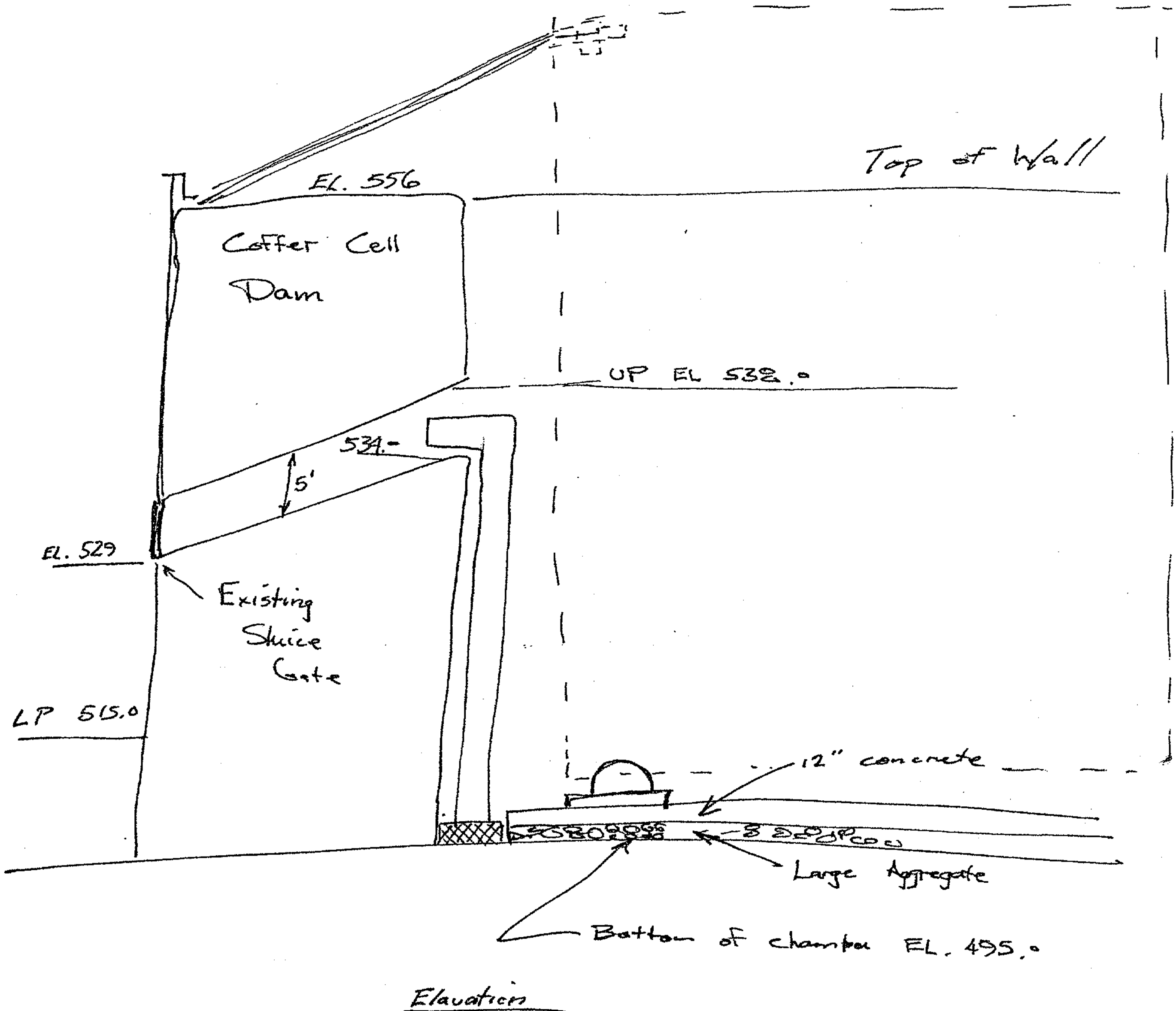
1. Increases the distance required to access the bottom of the dry dock facility.
2. Lowering the fill height may cause stability concerns with new criteria.

JUSTIFICATION:

The dry dock will be used in the future as a sandblasting and painting facility for miter gate rehab. The chamber will also be used as the only dry dock in the region which will accommodate the new heavy gate lifter.

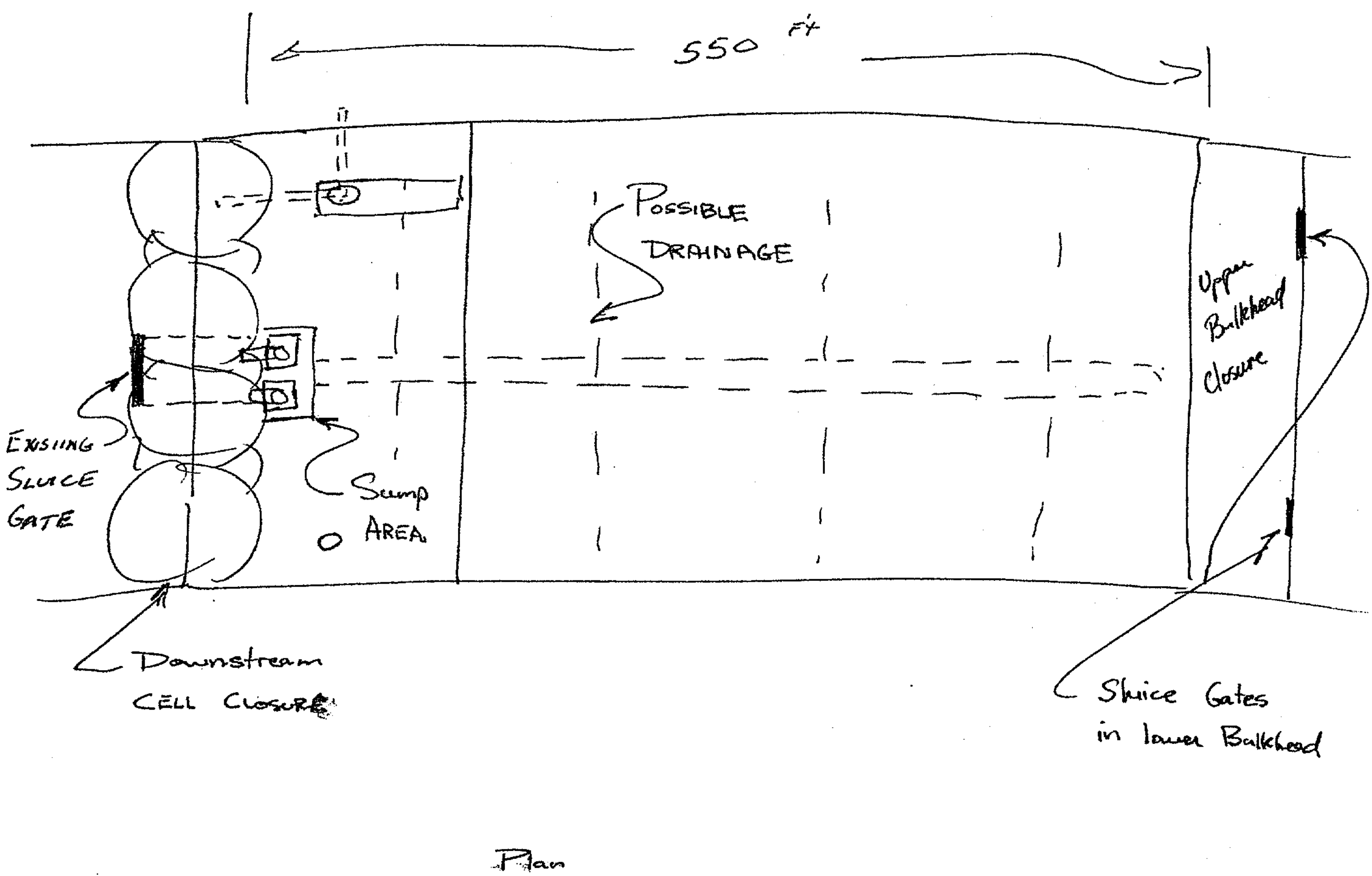
DRAWING NO. 1

PROPOSED DESIGN WITH SLUICE GATE AND CULVERT



DRAWING NO. 2

PROPOSED DESIGN WITH SLUICE GATE AND CULVERT



COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-11 Add Sluice Gate and Culvert to Empty Dry Dock				PAGE 4 OF 4

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Sand	CY	45,574	$11.00	$501,314
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$501,314

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Add sluice gates to upper bulkhead	EA	2	$10,000.00	$20,000
				$0
				$0
				$0
				$0
				$0
		Total Additions		$20,000
		Net Savings		$481,314
		Mark-ups	0.00%	$0
		Total Savings		$481,314

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-12
DESCRIPTION: Lift-In-Place Alternatives

ORIGINAL DESIGN:

The original lift-in system consist of lift-in towers and panels. Culvert sections are included in the lift-in towers.

PROPOSED DESIGN:

A concrete leveling frame is placed on the prepared rock bottom (by means of a setting frame), leveled and grouted. The culvert sections are placed on top of the concrete frame. Concrete side panels are placed in the slots, and braced with (sacrificed) steel. Tremie concrete to fill in between the panels.

ADVANTAGES:

1. The number of leveling frames is less than the number of lift-in towers.
2. Frames are easier to place than towers, better control.
3. Culvert and frame are separate placing operations, easier to perform.
4. System is more monolithic than towers and panels.
5. Lighter lifts.
6. Fewer heavy lifts.
7. Easier precasting.

DISADVANTAGES:

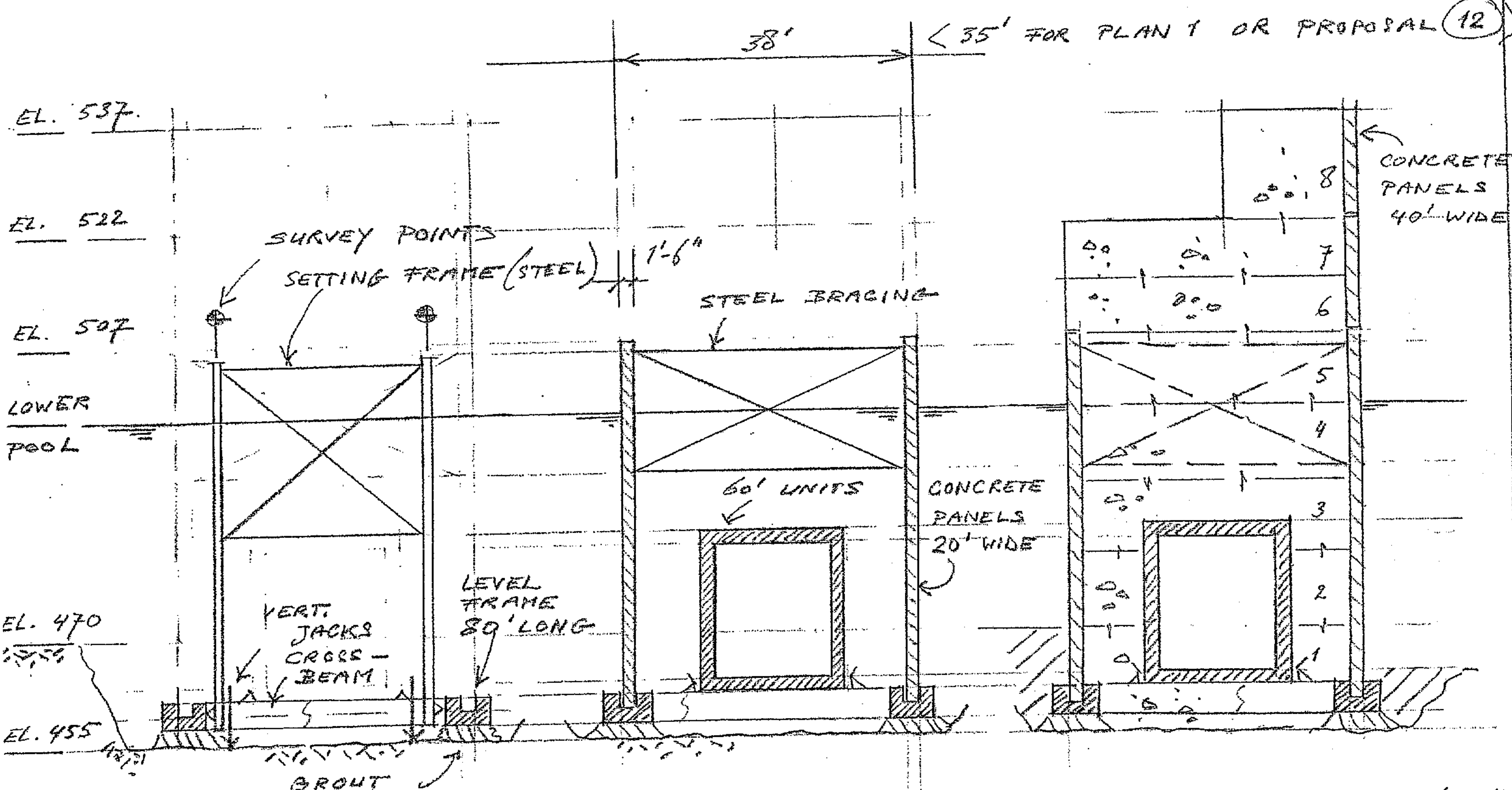
1. Temporary shoring is more complicated.

JUSTIFICATION:

One of several alternative lift-in techniques, this proposal can save money on materials and improve constructability. It can also be used if culvert is located behind wall.

NOTE: Any lift-in system would perform better when the cross over culvert is deleted.

DRAWING NO. 1



1. LIFT-IN CONCRETE LEVEL FRAME, USE JACKS ON SETTING FRAME TO LEVEL.
2. GROUT ALONG LENGTH. REMOVE SETTING FRAME.
3. PLACE 16'x18' CULVERT (LIFT-IN, FLOAT-IN OR COMBINATION)
4. LIFT-IN 20' WIDE PANELS ; STEEL BRACING.
5. TREMIE POURS 1 to 4
6. CAST IN PLACE POURS 5 to 8.

CALCULATIONS

COST COMPARISON: FOR 40' LONG WALL.

PLATE 2-24.	PROPOSAL
1. PRE-CAST CONCRETE	
- PANELS: $((537-467)+(507-467)) \times 1.5 \times 40' = \underline{6600}$ cuft	- PANELS: AS PLATE 2-24.
- SETTING TOWERS: $(499-485) \times (12 \times 22.5 - 4 \times 4.5 \times 6.5 - 2 \times 4.5 \cdot 2.5) + (485-462) \times (12 \times 4.5 - 2 \times 4.5 \cdot 3.5) = 1827 + 518 = 2345$ cuft	- LEVEL FRAME: $2 \times (4 \times 6 - 2 \times 2) \times 40' + 2 \times 4 \times 2 \times 30 = \underline{2080}$ cuft
$2345 \times \frac{40}{24} = \underline{3908}$ cuft.	
- CULVERT: $21 \times 18 - 18 \times 16 \times 40' = \underline{3600}$ cuft	- CULVERT: AS PLATE 2-24.
2.- MASS CONCRETE: $((537-459) \times 38 - 20 \times 15) \times 40 - 6600 - 3908 - 3600 = \underline{92452}$ cuft	- MASS CONCRETE AS PLATE 2-24 PLUS $3908 - 2080 = \underline{1828}$ cuft.
3.- STEEL ITEMS: NO DIFFERENCE	

cheaper pre-cast

COST DIFFERENCE:

$3908/27 \times \$575.- = \$83230,-/40'$

$2080/27 \times \$400.- = \$30800,-/40'$

$1828/27 \times \$165.- = \$11200,-/40'$

DIFFERENCE: $83230 - 30800 - 11200 = \$41300,-/40'$

FOR LANDWALL: 700 LF: $\frac{700}{40} \times 41300 = \$720000,-$

13 % saving on pre-cast = 0,13 · 7 mil.

= \$ 900.000,-

(total lift-in-place)

SAVING ON LAND WALL: ~ \$ 700.000,-

CALCULATIONS

PLATE 2-24	PROPOSAL
4. OPERATIONS <FOR 40'>	
- LIFT-IN TOWER (1,67 x)	- LIFT-IN FRAME (0,5 x)
- GROUT	- GROUT
	- PLACE CULVERT (0,67 x)
- LIFT-IN PANELS (3,34 x)	- LIFT-IN PANELS (4 x)

LEVEL FRAME ⇒ $2080 \times 150/2000 = 156$ shtons/40'

@ $\frac{110}{2} + 25 = 80'$ <12500' ton-ft>

CULVERT ⇒ $3600 \times 150/2000 = 270$ shtons/40'

@ $\frac{110}{2} + 12 = 67'$ (dry) < 18100 ton-ft>

submerged →

$0{,}6 \times 270$ @ 80' < 13000 ton-ft>

PANELS ⇒ $1440 \times 150/2000 = 108$ shtons/40'

@ $\frac{110}{2} + 12 = 67'$ < 7236 ton-ft>

@ $\frac{110}{2} + 45 = 100'$ < 10800 ton-ft>

Use 30000 ton-ft RINGER CRANE

Increase lengths to: LEVEL FRAME: 80'

CULVERT = 60'

(PANELS : 80')

FOR panels use M2250 @ 35'.

270 shton @ 80' : $1.17 \times \frac{700}{40} = 21$ lifts

vs. 300 shton @ 80' : $1.67 \times \frac{700}{40} = 29$ lifts

108 shton @ 35' : $4 \times \frac{700}{40} = 70$ lifts

vs 100 shton @ 35' : $3.34 \times \frac{700}{40} = 59$ lifts

CALCULATIONS

Assuming that the heavy crane is 3 times the cost of the lighter crane:

Plate 2-24: 29 * 3 + 59 * 1 = 146

PROPOSAL: 21 * 3 + 70 * 1 = 133

Saving: $1 - 133/146 = 10\%$.

0,10 * (650.000,– + 2070000,–) = 270000,–

COST ESTIMATE WORKSHEET				
PROPOSAL NO.: C-12 Lift-In-Place Alternatives				PAGE 6 OF 6
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Setting towers (partly)	CY	2,533	$575.00	$1,456,475
10% of equipment and manpower (precast)	LS	1	$270,000.00	$270,000
				$0
				$0
				$0
				$0
		Total Deletions		$1,726,475
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Level frame	CY	1,348	$400.00	$539,200
Additional tremie concrete	CY	1,185	$165.00	$195,525
				$0
				$0
				$0
				$0
		Total Additions		$734,725
		Net Savings		$991,750
		Mark-ups	0.00%	$0
		Total Savings		$991,750
For 700' landwall section				

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-13

DESCRIPTION: Compare Float-In versus Lift-In

ORIGINAL DESIGN:

The existing lock wall design utilizes lift-in concrete towers and panels with concrete infill. During construction of the middle wall monoliths, five 40-hour closures of both locks or ten 24-hour closures of both locks were estimated.

PROPOSED DESIGN:

The proposed lock wall design utilizes float-in concrete structures. A base "raft" is constructed at a dry dock (e.g., Galipollis) and is floated with an approximate 0-foot draft to the near site work station. At this area, the wall construction continues until the walls are high enough so that they will extend well above the water line when they are set into place. (For the structure adjacent to the existing main chamber, the adjacent wall should be fill height in order to minimize interruptions to navigation).

ADVANTAGES:

1. Possibly fewer interruptions to navigation.
2. On-site construction is simpler (underbase grouting, placement of infill concrete, and forming top of monoliths).
3. Lower cost.

DISADVANTAGES:

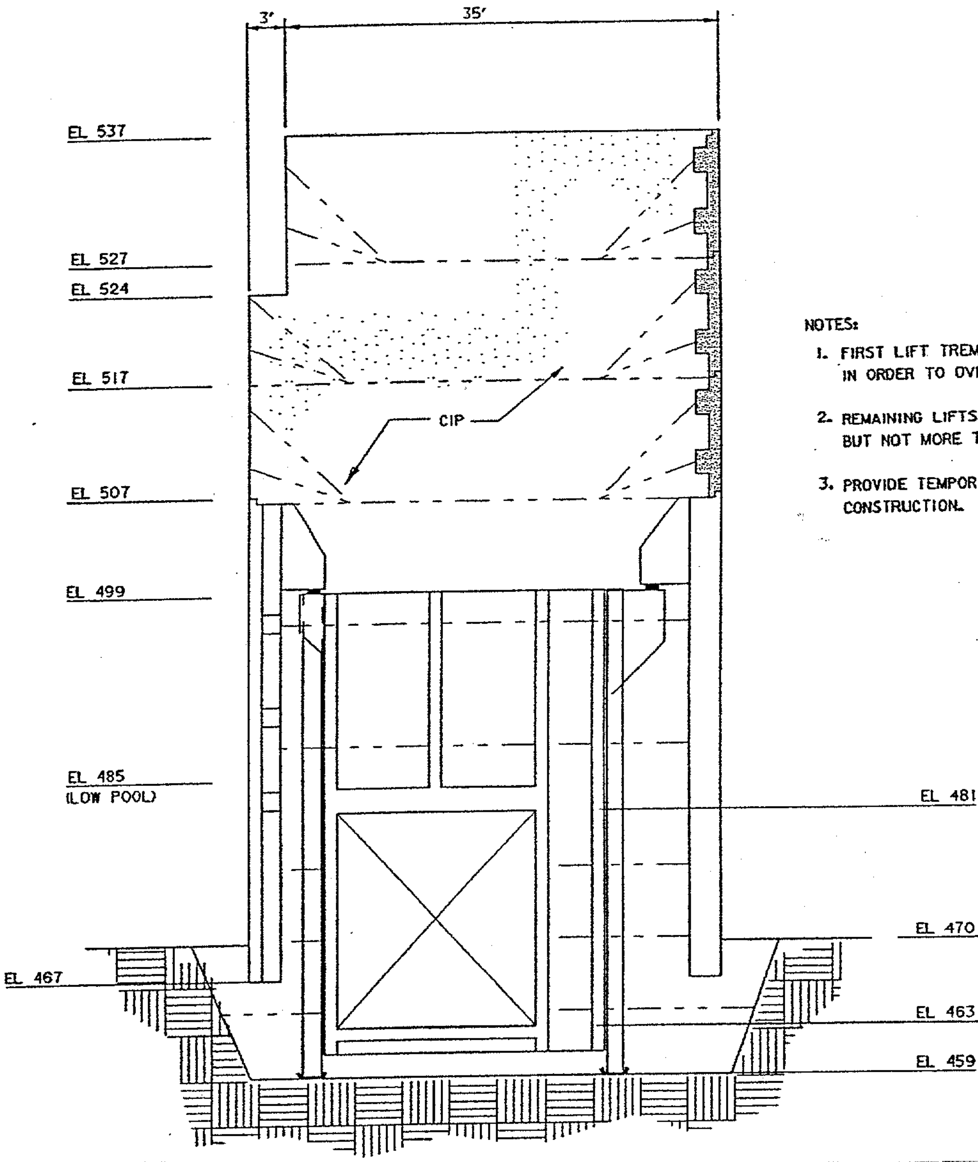
1. Additional dredging and rock excavation (for deep draft area at slipway and connecting channel).
2. Special expertise that fewer contractors may have.

JUSTIFICATION:

Further evaluation of float-in construction may be justified. Although additional dredging and rock excavation is required, the float-in unit cost appears to be substantially less than the lift-in unit cost. This cost difference is more than enough to offset the additional dredging and rock excavation required. The float-in construction will also reduce the amount of "in-channel" construction time, as more of the work will be completed at the dry dock and the near-site work station at the planned slipway.

DRAWING NO. 1

ORIGINAL DESIGN WITH LIFT-IN SECTION

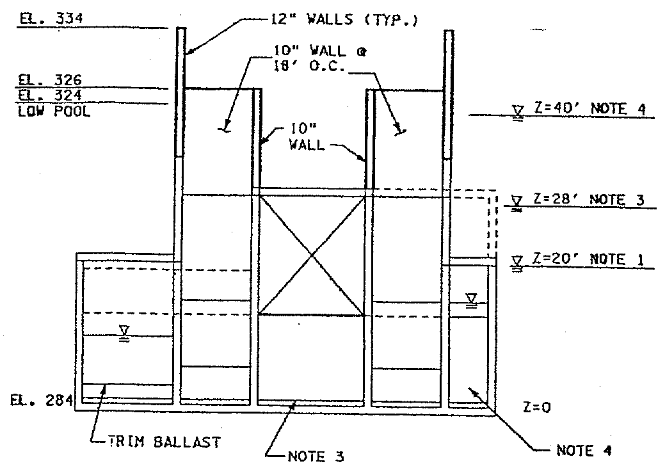


NOTES:

1. FIRST LIFT TREMIE SHALL NOT BE MORE THAN 8 FT IN ORDER TO OVERCOME BUOYANCE.
2. REMAINING LIFTS SHALL BE BY INCREASING ELEVATION, BUT NOT MORE THAN 10 FT EACH.
3. PROVIDE TEMPORARY BRACING INSIDE CULVERT DURING CONSTRUCTION.

DRAWING NO. 2

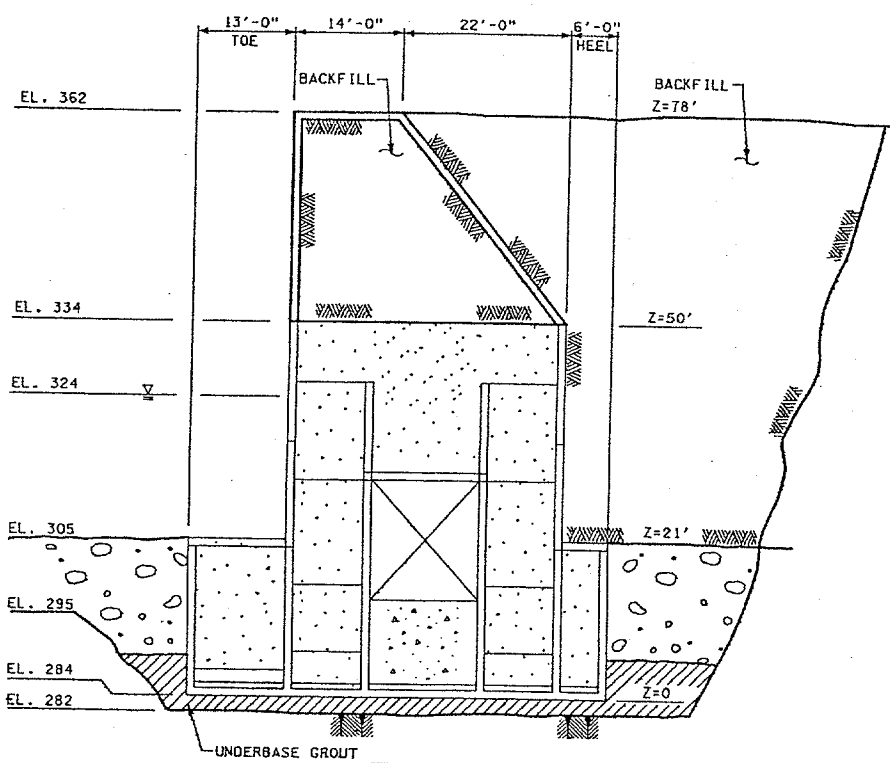
PROPOSED DESIGN WITH FLOAT-IN SECTIONS



TRANVERSE SECTION
SCALE: 1"=10'

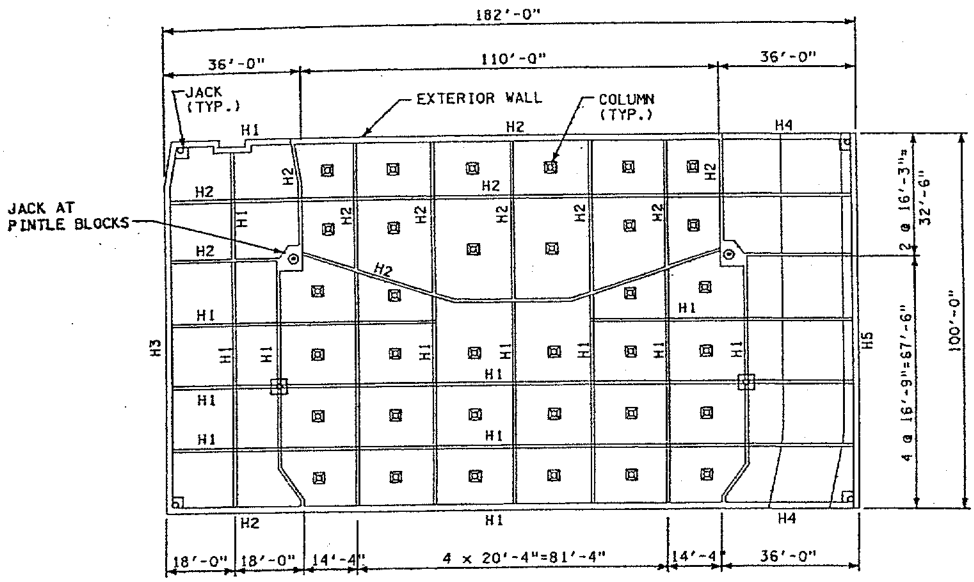
STAGE 3

1. CONTINUE SIDEWALL CONSTRUCTION TO 50' ABOVE BOTTOM OF BASE RAFT. DRAFT = 20'
2. TOW TO FINAL LOCATION.
3. TIE ADDITIONAL 12" THICKNESS STRUCTURAL CONCRETE SLAB TO KEEL SLAB.
4. BALLAST BENEATH CULVERT, HEEL AND TOE COMPARTMENTS TO LOWER WALL STRUCTURE TO EL. 284.

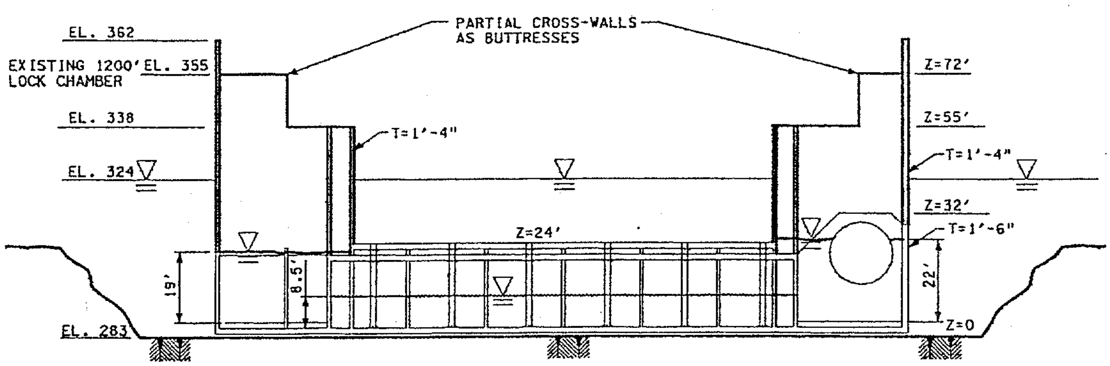


DRAWING NO. 2

PROPOSED DESIGN WITH FLOAT-IN MITER GATE BAY



PLAN
SCALE: 1"=20'



ELEVATION
SCALE: 1"=20'

STAGE 3

1. CONSTRUCT EXTERIOR SIDE WALLS TO EL. 362 AND INSIDE SIDE WALLS TO EL. 338. USE WATER BALLAST FOR TRIM.
2. TOW FROM OUTFITTING PIER (CONSTRUCTION MOORAGE AREA) TO SET-DOWN LOCATION. DRAFT APPROX. 21.1'.
3. ADD WATER BALLAST IN ACCORDANCE WITH ENGINEERED AND APPROVED BALLAST PLAN TO SET-DOWN STRUCTURE ON EITHER JACKING LEGS OR CONCRETE PEDESTALS WITH FLAT JACKS.

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: C-13 m Compare Float-In versus Lift-In				PAGE 5 OF 5
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
**	Lift-in monoliths	CY	93,150	$250.00	$23,287,500
					$0
					$0
					$0
					$0
					$0
			Total Deletions		$23,287,500
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Additional dredging required at slipway	CY	74,000	$11.00	$814,000
	Additional rock excavation at slipway and	CY	60,000	$22.00	$1,320,000
	connecting channel				$0
**	Float-in monoliths	CY	93,150	$220.00	$20,493,000
					$0
					$0
			Total Additions		$22,627,000
			Net Savings		$660,500
			Mark-ups	0.00%	$0
			Total Savings		$660,500
**	Unit cost includes wall embedments				

DESCRIPTION: Float-In Version of Tin Can Concept

ORIGINAL DESIGN:

Nose pier is made of stacked pre-cast concrete units.

PROPOSED DESIGN:

The float-in method is technically not feasible for the concrete nose pier caisson. (Structure is too tall and water depth is not sufficient). However, the float-in method is feasible for the steel nose pier caisson.

Remarks:

Upstream: One piece structure 85 feet tall → built downstream or upstream.
Crane barge guidance is required.

Downstream: One piece structure 36 feet tall → built downstream or upstream.
Heavy lift crane is required.
Therefore it is advised to float-in the lower part and construct In-situ the upper part.

Compared to the Mississippi protection cell (35-foot diameter by 45 feet) the float-in steel caisson needs stiffeners due to outside water pressure.

ADVANTAGES:

1. There is less disturbance of shipping traffic and increased durability when compared to building a steel sheet pile cell ($1.7 million upstream).
2. Compared to alternative 3B, stacked concrete shells with pipe struts ($2.5 million upstream), there is less disturbance. For upstream nose pier only, no heavy crane barge required, no stacking provisions, less tolerance problems, equal durability or better (no horizontal joints), and no labor intensive wear strips.

Total project saving:	Upstream	$1.0 million
	Downstream	$0.7 million
		$1.7 million

The advantages compared to the sheet pile cell:

Cost extra for upstream	$0.6 million
Cost extra for downstream	$0.7 million
	$1.3 million

DISADVANTAGES:

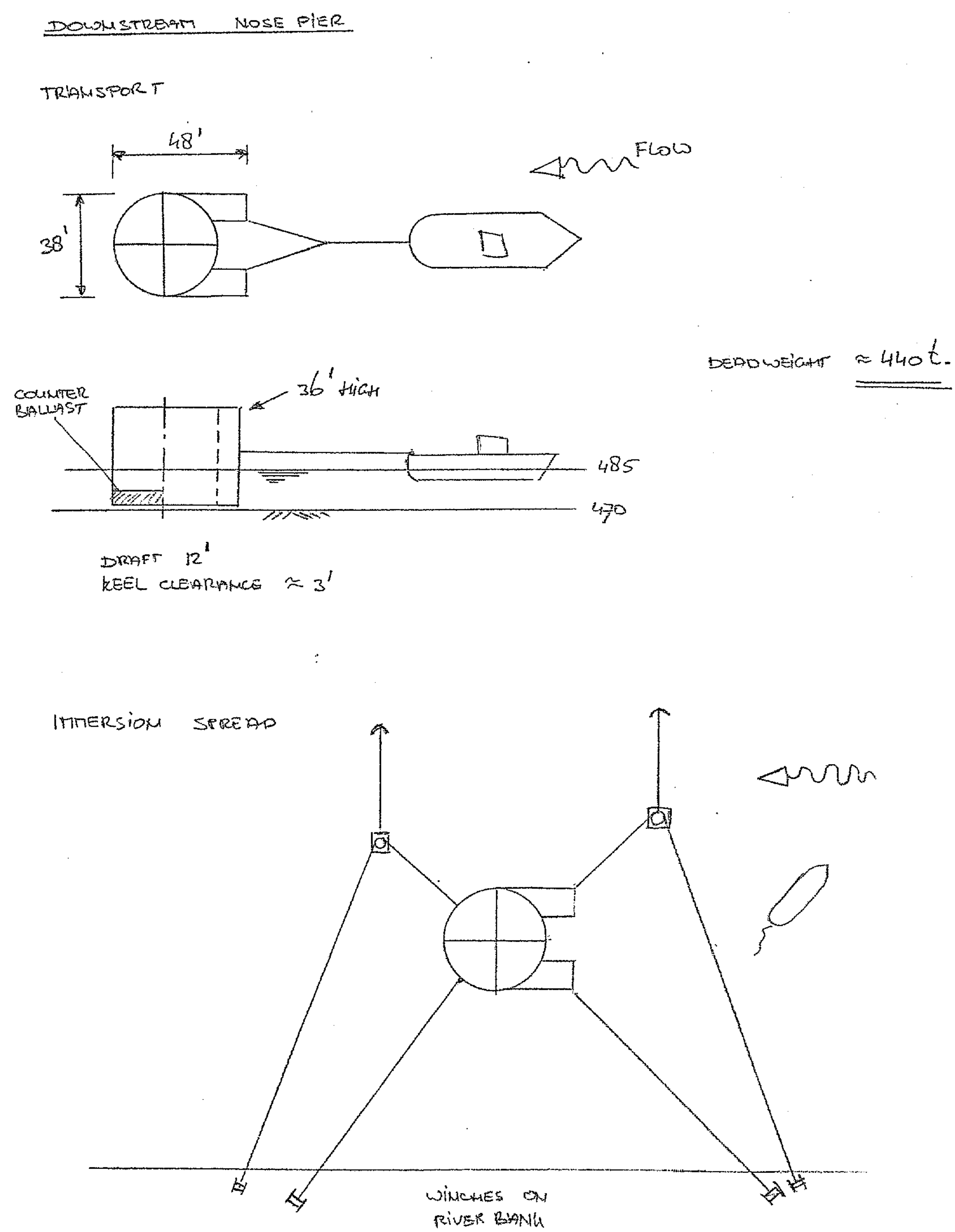
For downstream nose piers: Still substantial construction work on the river.

For upstream and downstream: Grouting under the caisson base is required (instead of tremie concrete as used for stacked prefab elements.

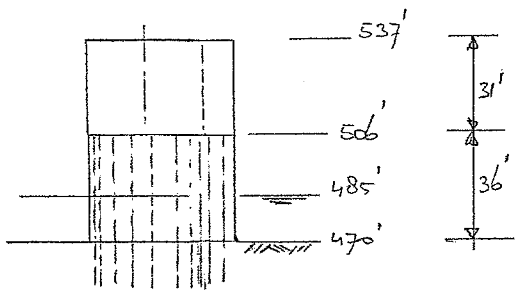
JUSTIFICATION:

The primary justification for this proposal is the increased durability. Saving approximately $1 million is also a benefit of this proposal. Thirdly, an increase in constructability will also add value.

DRAWING NO. 1


DOWNSTREAM NOSE PIER
TRANSPORT
48'
38'
FLOW
DEADWEIGHT ≈ 440t.
COUNTER BALLAST
36' HIGH
485
470
DRAFT 12'
KEEL CLEARANCE ≈ 3'
IMMERSION SPREAD
WINCHES ON RIVER BANK

DRAWING NO. 2



67'/85' *
FOR DOWN STREAM

ASSUMED COSTS : IN BETWEEN • STACKED STEEL SHELLS (38) $ 2.6 m | 2 m
• SHEET PILE WALL (28) $ 1.7 m | 1.3 m

SAY $ 1.65 m.

LESS CHANNEL DISTURBANCE C.T. CHEAPER SHEET PILE

THIS ADVANTAGE COSTS

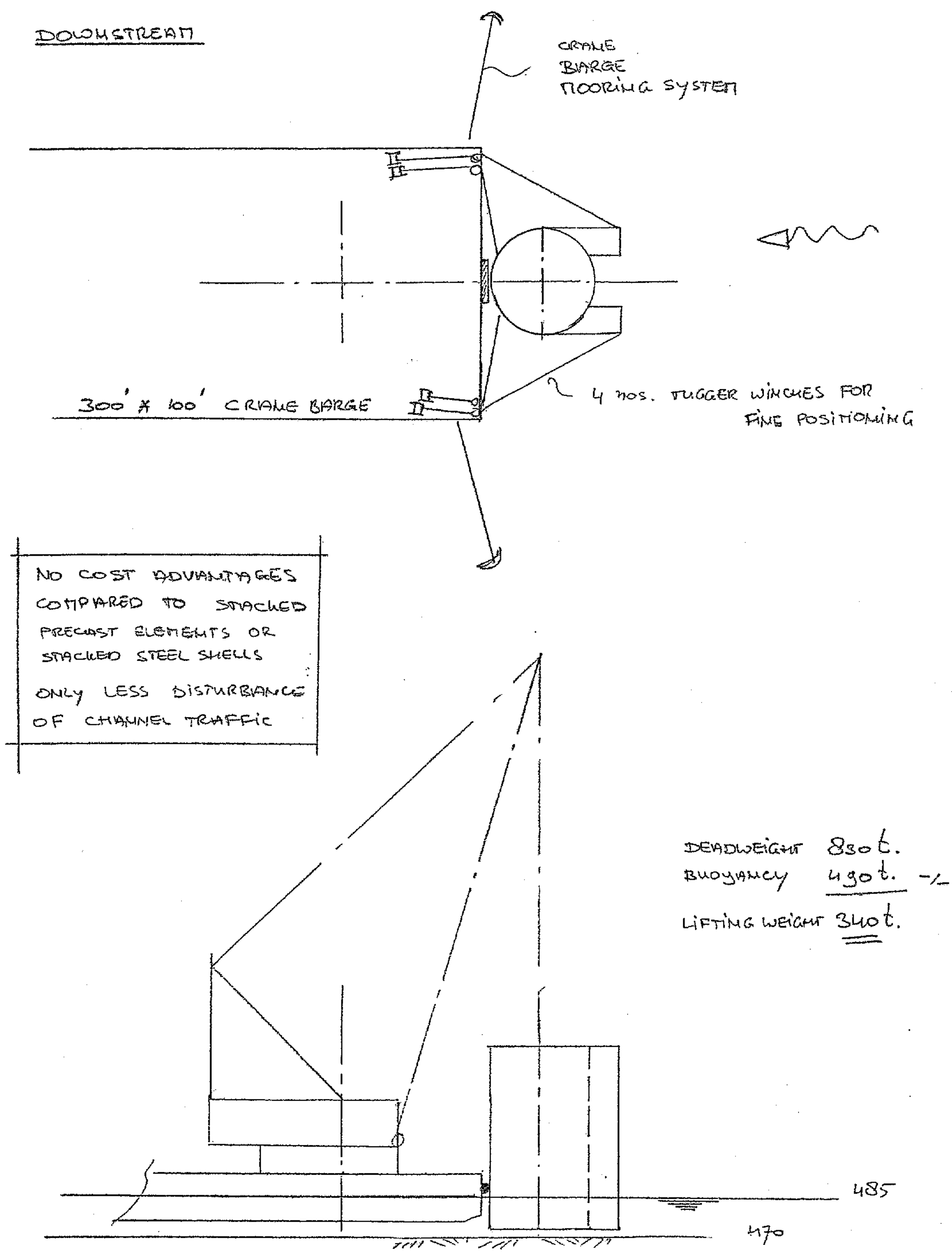
$\underset{\text{NOSE PIERS}}{\underline{2}} * (1.65 - 1.3) = \underline{\underline{0.7}}$ m

OR COMPARED TO STACKED CONCRETE SHELLS ($ 2.5 million)

67'/85' * 2.5 = $ 2 million

SAVING 2 * (2 - 1.65) = 0.7 $ million

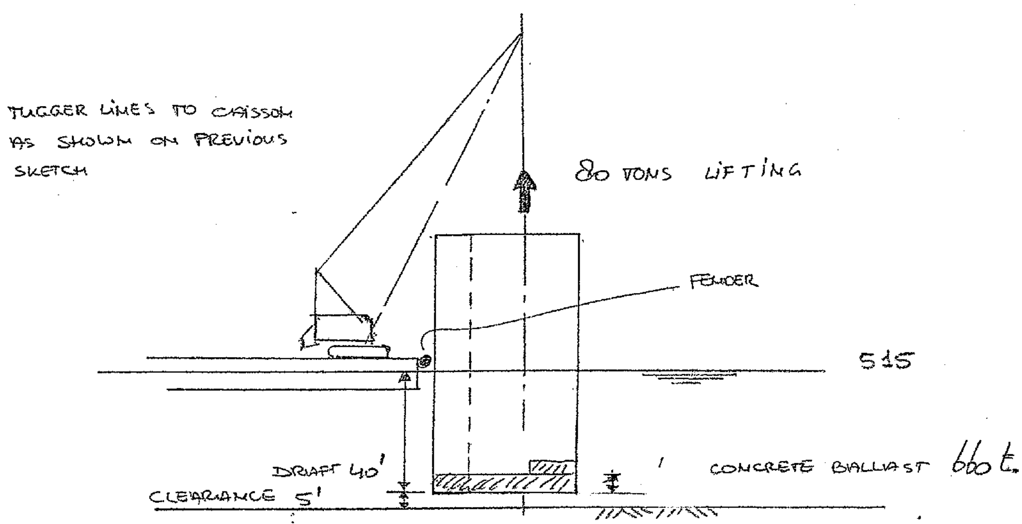
DRAWING NO. 3


DOWNSTREAM
CRANE
BARGE
MOORING SYSTEM
300' x 100' CRANE BARGE
4 nos. TUGGER WINCHES FOR
FINE POSITIONING
NO COST ADVANTAGES
COMPARED TO STACKED
PRECAST ELEMENTS OR
STACKED STEEL SHELLS
ONLY LESS DISTURBANCE
OF CHANNEL TRAFFIC
DEADWEIGHT 830t.
BUOYANCY 490t. -/.
LIFTING WEIGHT 340t.
485
470

DRAWING NO. 4

UPSTREAM NOSE PIER (CONSTRUCTED UPSTREAM)

THE FLOAT-IN OF 85' CAISSON IS NOT STABILE (OWN DRAFT 26')
USE CONCRETE BALLAST AND
GUIDANCE BY CRANE BARGE



BUOYANCY 40' * 40 = 1600 t
LIFTING 80 t. +
1680 t.

DEADWEIGHT 85' * 12 = 1020 t.
BALLAST = 660 t.
1680 t.

COSTS MORE CLOSE TO DUE TO LOWER CRANE CAPACITY
- STACKED STEEL SHELLS (3B) $ 2.6 m.
- SHEET PILE WALL (2B) $ 1.7 m.

SAY $ 2.0 m.

LESS CHANNEL DISTURBANCE COMPARED TO CHEAPER SHEET PILE

THIS ADVANTAGE COSTS

$2_{\text{NOSE}} * (2.0 - 1.7) = \$ 0.6$ m

OR SAVING ON STACKED CONCRETE SHELLS 2 * (2.5 - 2.0) = $ 1.0 m

COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-14 Float-In Version of Tin Can Concept

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Concrete for shell	EA	1	$1,700,000.00	$1,700,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$1,700,000

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$0
		Net Cost Decrease		$1,700,000
		Mark-ups	0.00%	$0
		Total Cost Decrease		$1,700,000

PROPOSAL NO:	C-15	PAGE NO: 1 OF 3
DESCRIPTION:	Straighten Culvert	

ORIGINAL DESIGN:

Original design adds a new Supplemental Filling/Emptying System and starts with construction of the Intake Structure. The Intake Structure will be excavated in the dry after a cutoff wall is constructed from the existing land wall to the existing riverbank. Excavation will use conventional excavators and will stop at the approximate elevation of 480 feet where the structure will be founded on soil. The next feature of the system includes construction of a 1,200-foot bypass culvert to be buried in a trench varying from 50 feet deep to 70 feet deep. In the next section of the system, culverts are incorporated in the construction of the land wall monoliths. Laterals extend from the land wall across the chamber at elevation 460 feet and will be constructed in the dry.

PROPOSED DESIGN:

Use New Supplemental Filling culvert system, but straighten the culvert beginning at the first thrust block (Station 2+30) and connecting to the line at the third trust block (Station 11+00). The new alignment is also between the existing highway bridge piers. The culvert valve also serves as the connecting thrust block.

ADVANTAGES:

1. Cost savings from less volume of excavation, which is deep and in some rock.
2. Cost savings by eliminating two trust blocks.
3. Cost savings from less pipe and elbows which add to pipe losses.

DISADVANTAGES:

1. None apparent.

JUSTIFICATION:

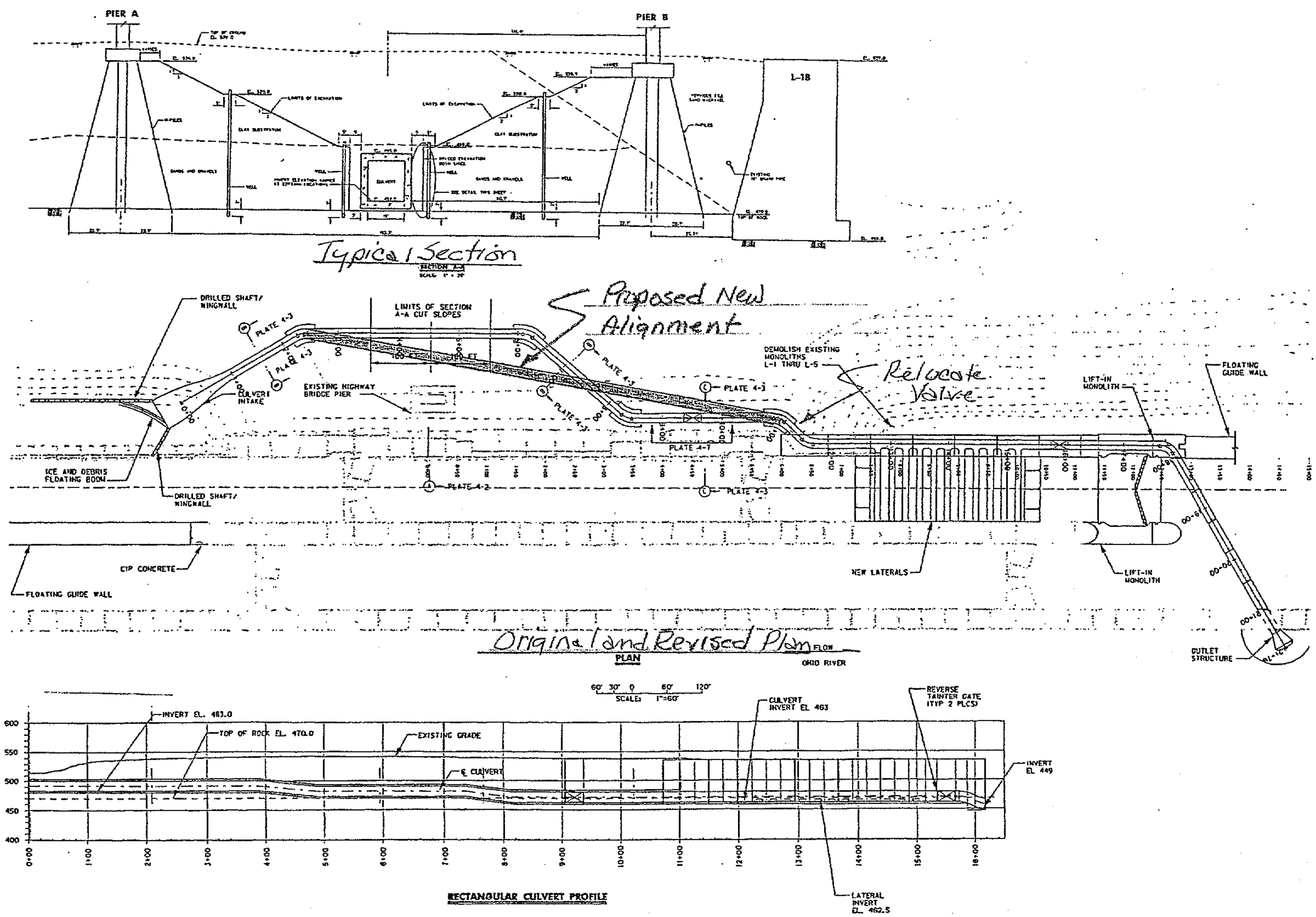
The Plan 3 addition of the new Filling/Emptying System is to assure the same lockage times with the newly extended auxiliary lock that exists with the existing main lock. This proposal offers a new alignment with the culvert straightened to offer cost savings and a more effective design.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-15 PAGE NO: 2 OF 3

DRAWING NO. 1:

EXISTING AND PROPOSED FILLING CULVERT PLAN AND TYPICAL SECTION



VALUE ENGINEERING PROPOSAL

	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: C-15 Straighten Culvert Pipe				PAGE 3 OF 3
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Dry Earth Excavation	CY	58,334	$9	$546,590
	Culvert Rock Excavation	CY	3,834	$26	$98,917
	CIP Concrete Bypass Culvert**	CY	1,142	$560	$639,577
	CIP Thrust Blocks	CY	800	$311	$248,992
					$0
					$0
					$0
**	Valve moved to final thrust block at monolith				$0
					$0
					$0
					$0
					$0
			Total Deletions		$1,534,076
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Additions		$0
			Net Cost Decrease		$1,534,076
		*	Mark-ups	0.00%	$0
			Total Cost Decrease		$1,534,076

DESCRIPTION: Same Alignment by Micro-Tunnel versus Braced Open Excavation

ORIGINAL DESIGN:

The original design adds a new Supplemental Filling/Emptying System and starts with construction of the Intake Structure. The Intake Structure will be excavated in the dry after a cutoff wall is constructed from the existing land wall to the existing riverbank. Excavation will use conventional excavators and will stop at the approximate elevation of 480 feet where the structure will be founded on soil. The next feature of the system includes construction of a 1,200-foot bypass culvert to be buried in a trench varying from 50 feet deep to 70 feet deep. In the next section of the system, culverts are incorporated in the construction of the land wall monoliths. Laterals extend from the land wall across the chamber at elevation 460 feet and will be constructed in the dry.

PROPOSED DESIGN:

This proposal uses the original approximately 1,100 lineal foot culvert alignment and micro-tunneling to excavate the culvert in place of open cutting. An alternate alignment along the existing lock landwall is presented in another proposal. The gate should be relocated adjacent to or within the extended monolith sections to optimize the filling culvert tunneling process.

ADVANTAGES:

1. Cost savings in excavation.
2. Eliminates large area disturbance for culvert construction.

DISADVANTAGES:

1. Adding a subcontractor with high degree of risk.
2. Pressure pipe would be tested in place.

JUSTIFICATION:

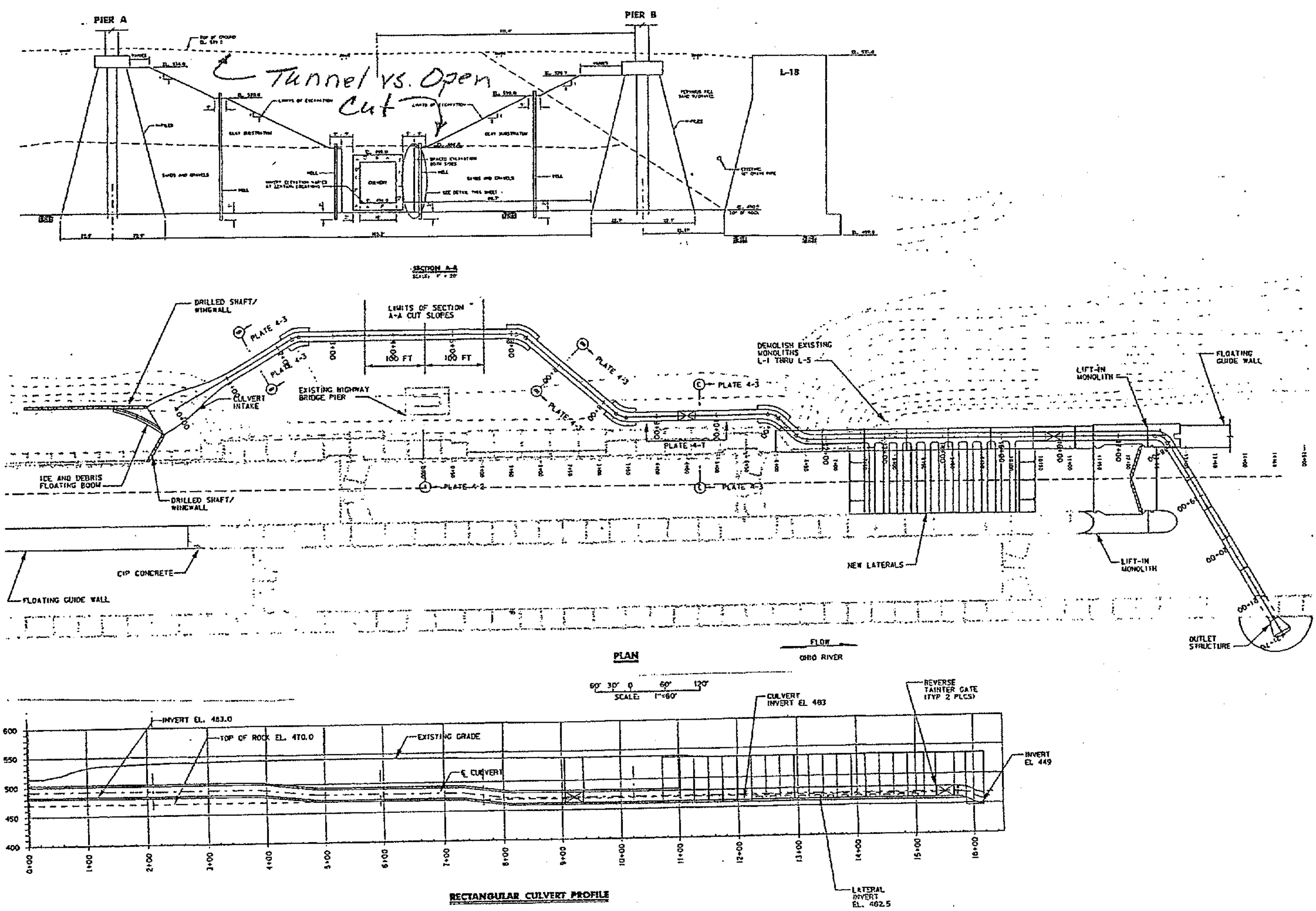
Lower excavation cost is achieved with the tunneling technique as compared to the braced open excavation method.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-16 PAGE NO: 2 OF 3

DRAWING NO. 1:

EXISTING FILLING CULVERT PLAN AND TYPICAL SECTION



VALUE ENGINEERING PROPOSAL

COST ESTIMATE WORKSHEET				
PROPOSAL NO.: C-16 Use Same Alignment for Culvert by Micro-Tunnel				PAGE 3 OF 3
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Dry earth excavation	CY	350,000	$9.37	$3,279,500
Shoring for excavation	SF	11,200	$39.62	$443,744
Culvert rock excavation	CY	23,000	$25.80	$593,400
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$4,316,644
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Micro-tunneling	LF	1,200	$2,300.00	$2,760,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$2,760,000
		Net Cost Decrease		$1,556,644
		Mark-ups	0.00%	$0
		Total Cost Decrease		$1,556,644

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-17 PAGE NO: 1 OF 2

DESCRIPTION: Culvert next to Lockwall, Micro-Tunnel at Tower, Shore against Lock

ORIGINAL DESIGN:

The original design adds a New Supplemental Filling/Emptying System and starts with construction of the Intake Structure. The Intake Structure will be excavated in the dry after a cut-off wall is constructed from the existing land wall to the existing riverbank. Excavation will use conventional excavators and will stop at (approximate) elevation 480 where the structure will be founded on soil. The next feature of the system includes construction of a 1,200-foot bypass culvert to be buried in a trench varying from 50 feet deep to 70 feet deep. In the next section of the system, culverts are incorporated in the construction of the land wall monoliths. Laterals extend from the land wall across the chamber at elevation 460 and will be constructed in the dry.

PROPOSED DESIGN:

Use micro-tunneling to excavate the culvert in place of open cutting.

ADVANTAGES:

1. Cost savings in excavation.
2. Eliminates large area disturbance for culvert construction.

DISADVANTAGES:

1. Adding a subcontractor with high degree of risk.
2. Pipe would be tested in place.

JUSTIFICATION:

The primary justification for this proposal is the simplification of construction and an overall project cost savings of more than a million dollars. The mirco-tunneling process is a cost-effective solution and many contractors have this capability. Lower excavation cost is achieved with the tunneling technique as compared to the braced open excavation method.

COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-17 Culvert next to Lockwall, Micro-Tunnel at Tower

PAGE 2 OF 2

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Conventional construction	LS	1	$4,085,760.00	$4,085,760
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$4,085,760

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Micro-tunneling	LS	1	$2,760,000.00	$2,760,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$2,760,000
		Net Cost Decrease		$1,325,760
		Mark-ups	0.00%	$0
		Total Cost Decrease		$1,325,760

PROPOSAL NO: C-18
DESCRIPTION: Incorporate the Fill Valve into the Landwall Extension

ORIGINAL DESIGN:

See Greenup ETA Plate 2-13 (Plan 3). (See Drawing No. 1).

PROPOSED DESIGN:

Relocate the filling valve from esplanade (Station 4+50) to within the lockwall at Station 7+00. (See Drawing No 2).

NOTE: This proposal has similar impacts as Proposal C-17.

ADVANTAGES:

1. Reduces cost by eliminating the isolated auxiliary downstream filling valve monolith. This is done by using the weight of a proposed wall monolith to house the valve structure. Since the wall monolith is going to be built anyway, the proposed valve monolith is free.

DISADVANTAGES:

1. This proposal eliminates the smooth hydraulic transition to/from the culvert valve.
2. Will require extra WES modeling.

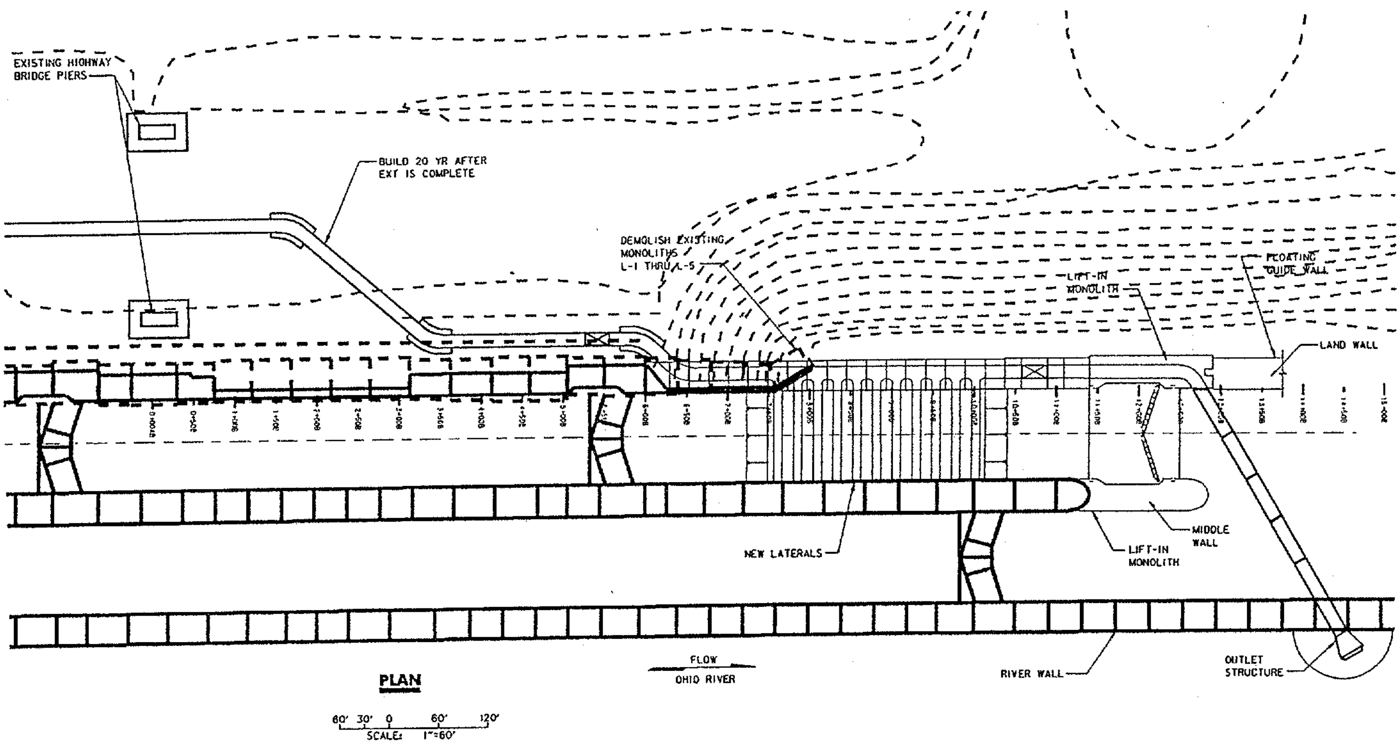
JUSTIFICATION:

This alternative needs to be investigated. The problems are with the hydraulic considerations. The final solution may have to include directional fins within the culvert bends to reduce hydraulic losses. Also, to compensate for hydraulic losses, the culvert may have to be enlarged.

Like Proposal C-17, the normal hydraulic considerations being used to design an ideal wrap around culvert are already out the window. This design will be a one-of-a-kind design and we will need to investigate ideas like these.

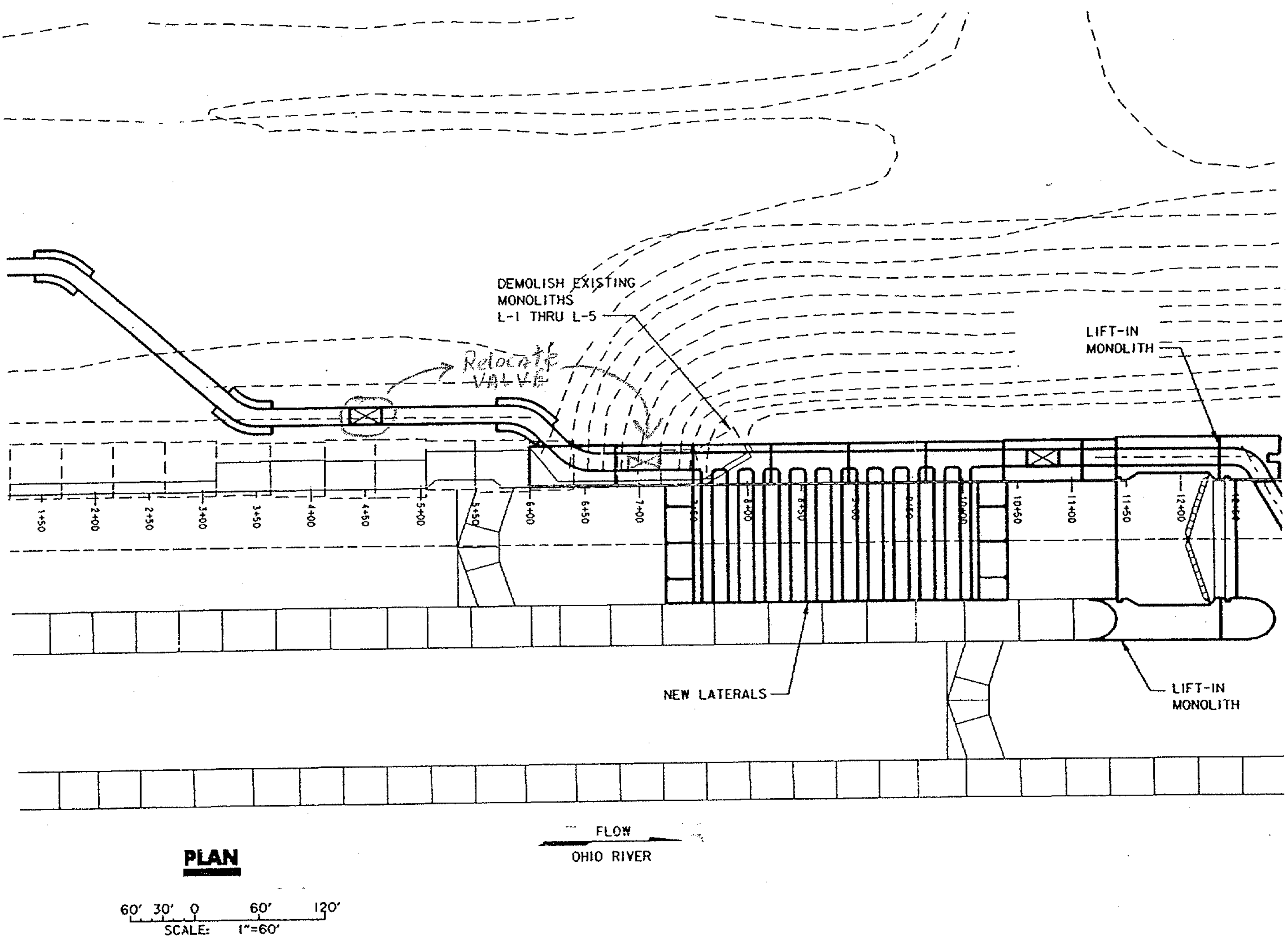
DRAWING NO. 1

EXISTING DESIGN



DRAWING NO. 2

PROPOSED DESIGN RELOCATING FILL VALVE



	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: C-18 Incorporate the Fill Valve into the Landwall Extension				PAGE 4 OF 4
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	CIP valve structure 05.00.64.16.845	CY	900	$913.45	$822,105
*	Reinforcing .860	LB	400,000	$0.63	$252,000
					$0
					$0
					$0
					$0
			Total Deletions		$1,074,105
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
					$0
					$0
					$0
					$0
					$0
			Total Additions		$0
			Net Savings		$1,074,105
			Mark-ups	0.00%	$0
			Total Savings		$1,074,105
*	Assume reduction in concrete for landwall based culvert is offset by increase cost for forming				

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-19

DESCRIPTION: Make Downstream Entry Point as Far Downstream as Possible

ORIGINAL DESIGN:

See Greenup ETA Plate 2-13 (Plan 3). (See Drawing No. 1).

PROPOSED DESIGN:

Change the point from where the culvert enters the landwall at station 6+25 to station 7+25. (See Drawing No 2).

ADVANTAGES:

1. The original design will demolish monoliths L-1 through L-5. This proposal will reduce the demolition to just L-1 and L-2.
2. Savings will not demolishing monoliths L-5 through L-3; and the rebuilding these sections of the walls using an in-the-wet technique.
3. Because of less demolition time, construction could be quicker, especially if this was on the critical path.

DISADVANTAGES:

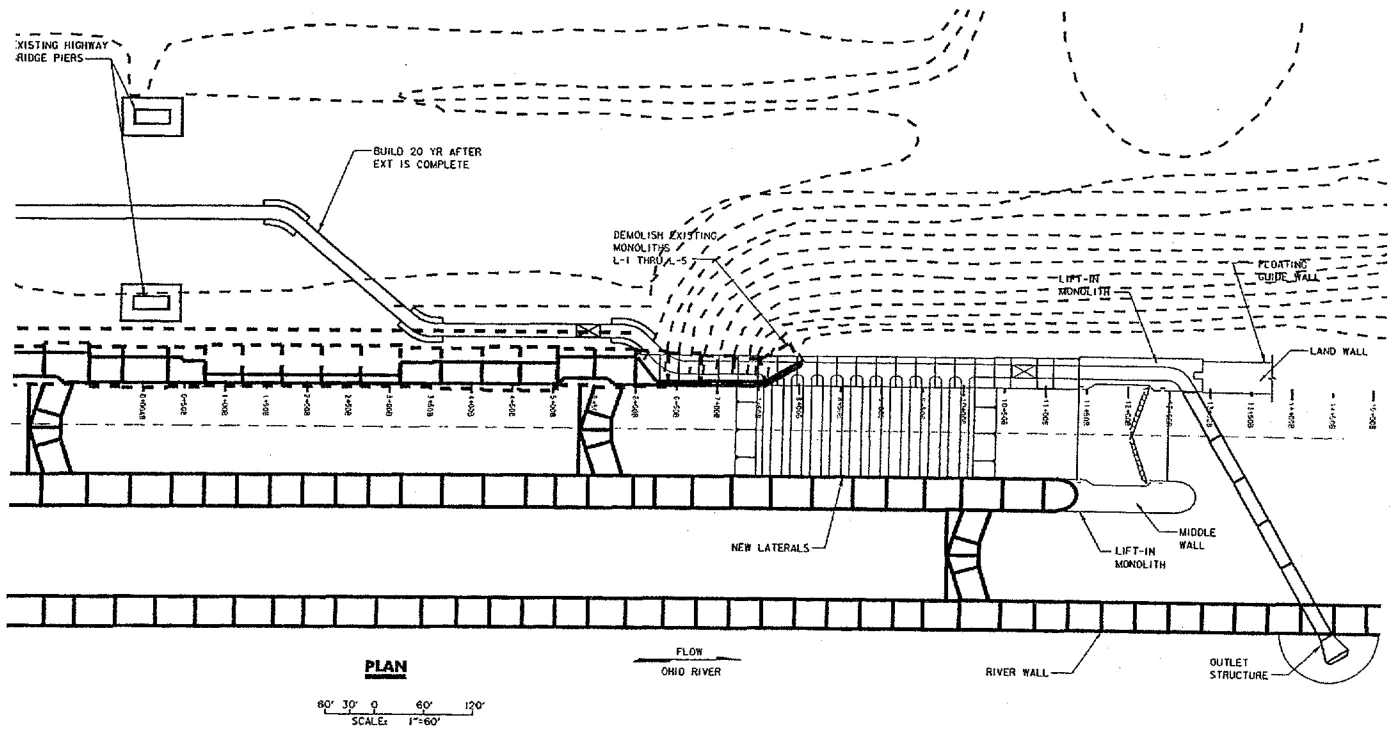
1. Monoliths L-3 through L-5 will need rock anchors for stability.
2. This proposal eliminates the smooth hydraulic transition from where it enters the wall until it reaches the first lateral.
3. Lack of demolition concrete could affect the construction of environmental mitigation dikes.
4. Will require extra WES modeling.

JUSTIFICATION:

This alternative needs to be investigated. The problem has to do with the hydraulic considerations. The final solution may have to include a larger filling culvert to off set hydraulic losses, (flow) directional fins within the culvert bends to reduce hydraulic losses, and may only be able to reduce the demolition of one or two monoliths. The hydraulic considerations used for an ideal culvert design are already out of the window with the wrap around culvert.

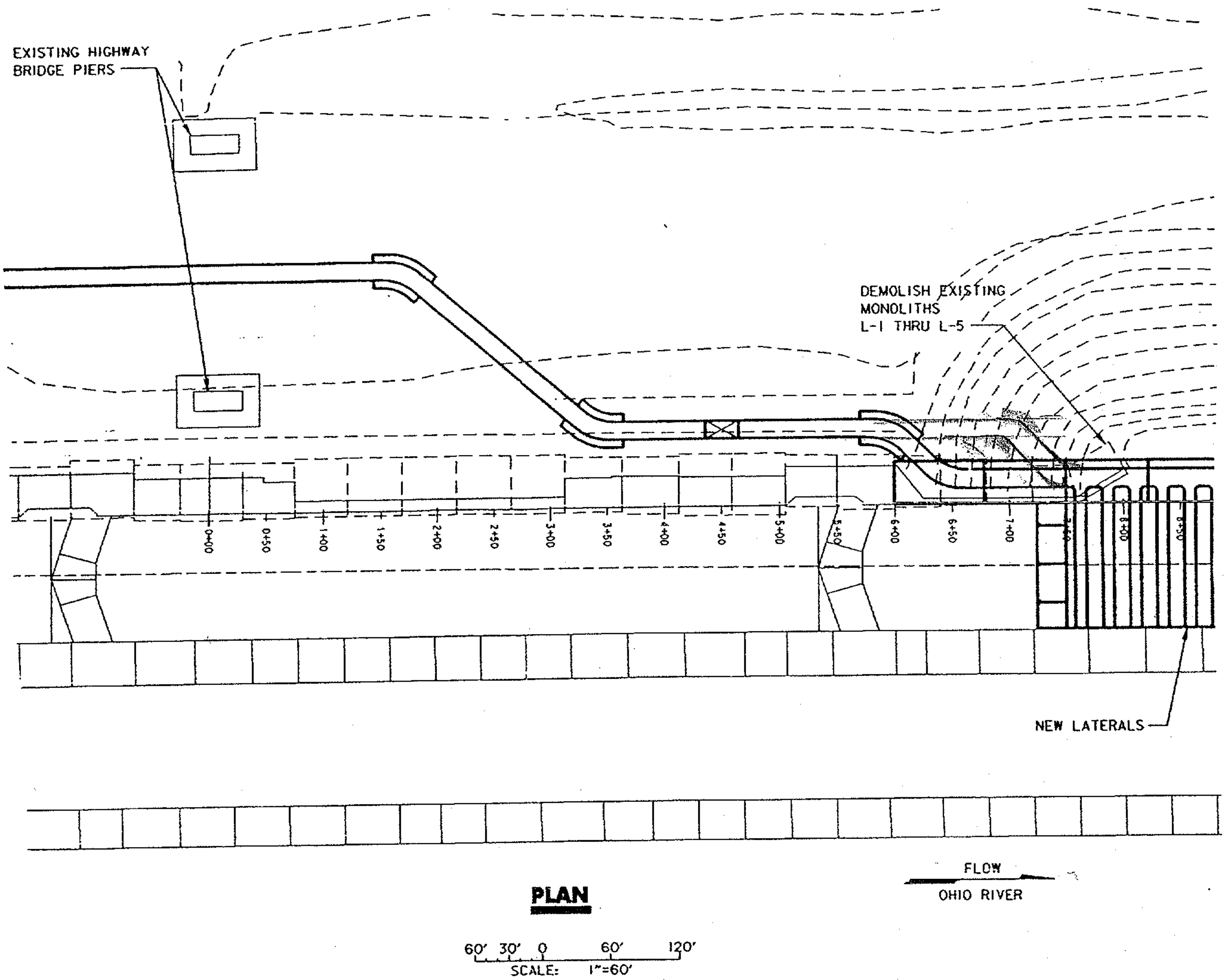
DRAWING NO. 1

EXISTING DESIGN



DRAWING NO. 2

PROPOSED DESIGN WITH ENTRY POINT DOWNSTREAM



COST ESTIMATE WORKSHEET				
PROPOSAL NO.: C-19 Make Downstream Entry Point as Far Downstream as Possibl				PAGE 4 OF 4
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
L-5 demolition	CY	3,600	$133.50	$480,600
L-4 demolition	CY	3,050	$133.50	$407,175
L-3 demolition	CY	2,900	$133.50	$387,150
Downstream steel and armor (60%)	EA	1	$11,310.00	$11,310
120' of new lock wall	CY	11,000	$250.00	$2,750,000
				$0
		Total Deletions		$4,036,235
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Rock anchors	EA	24	$22,500.00	$540,000
Additional Filling/Empty modeling at WES	LS	1	$75,000.00	$75,000
Changes to Filling/Empty system	LS	1	$500,000.00	$500,000
				$0
				$0
				$0
		Total Additions		$1,115,000
		Net Savings		$2,921,235
		Mark-ups	0.00%	$0
		Total Savings		$2,921,235
Assume eroded area is a depth -5'				
Training dike: 1 slope from -5- to +2- with 2' crown				
#1 stone				

DESCRIPTION: Use a Downstream Pump Station for New Filling Capacity

ORIGINAL DESIGN:

Current plan installs a 15.5-foot by 16.5-foot concrete box filling culvert with gravity flow from the intake structure located at the upstream landside lock wall. This culvert delivers half of the lock filling volume for the new extended lock and the existing in-wall culvert provides the other half. Both filling culverts discharge through in-floor laterals. A new Filling/Emptying Lateral System is designed for the new lock extension. (See Drawing No. 1).

PROPOSED DESIGN:

It is recommended that the new filling system incorporate a 1,600 CFS pump station to pump lower pool water to fill the lock. A filling weir feeding system will pass fill water to the new laterals. The existing culvert and laterals remain in service. The existing and new emptying system remains unchanged, however the new emptying culvert may be developed as the filling culvert to the new pump station. (See Drawing No. 2).

ADVANTAGES:

1. Eliminates extensive culvert and filling valve deep excavation.
2. Eliminates the filling valve and structure.
3. Significantly reduced construction effort and time.
4. Provides desired filling time and filling conditions (wave forces).

DISADVANTAGES:

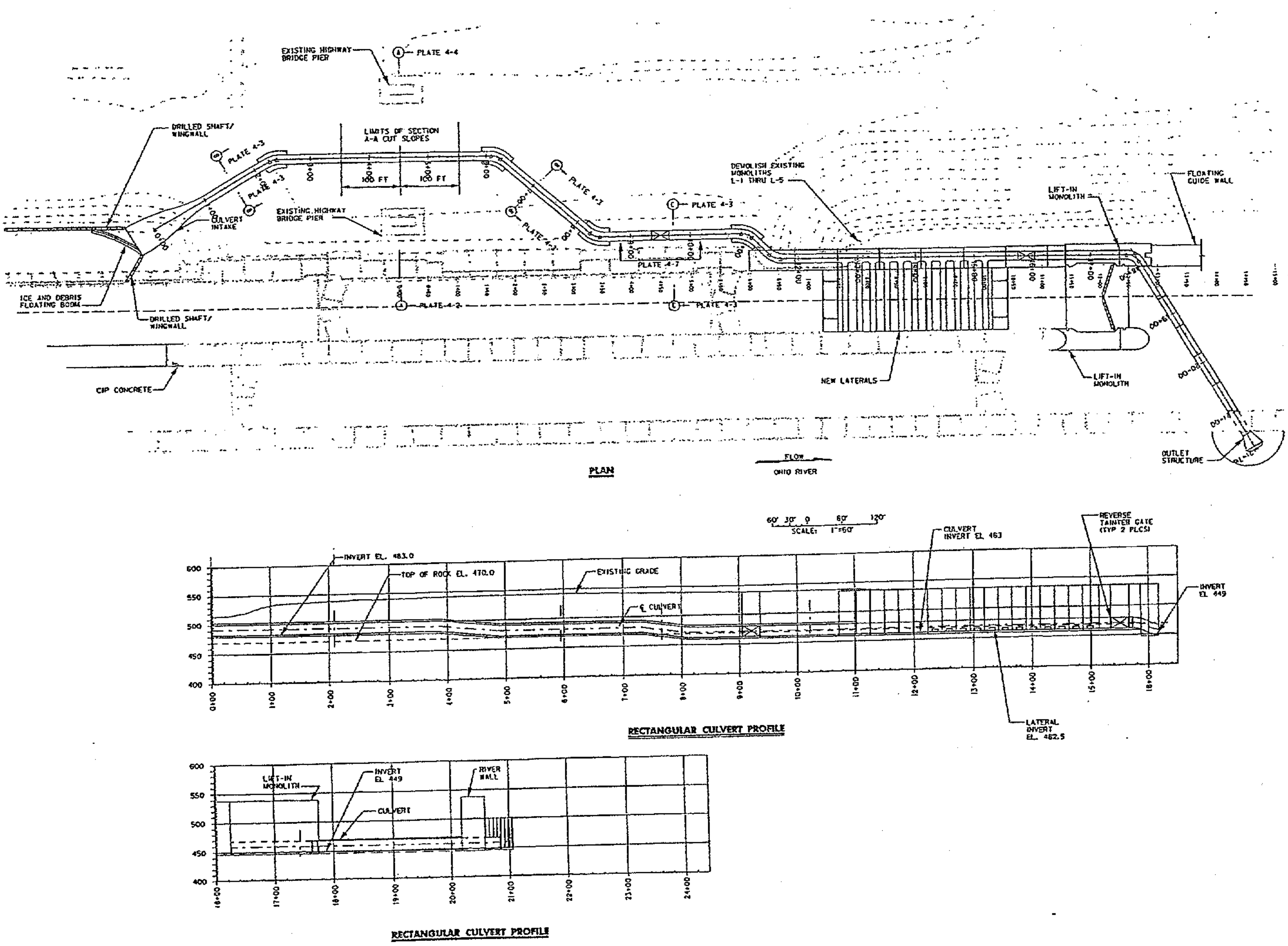
1. Adds a major mechanical system to the project.
2. Some extended maintenance O&M is required.
3. Energy cost and reliability for mechanical versus gravity is at issue.

JUSTIFICATION:

The function of filling may be accomplished by pumping. Using the 1,600 CFS pump station to provide filling from the lower pool eliminates the extensive site excavation for the deep filling culvert and filling valve. A filling weir is used to serve the lock laterals. The relatively high initial cost for the culvert system make this option viable. Added O&M cost are reasonable and do not offset the significant first cost savings. A reasonable level of reliability is considered for the pumping system. If the pump is out of service, the existing filling system can be used with an extended filling time and connection to the backup generator power may also be considered. The existing and new emptying culverts are retained, however, the new emptying culvert serves the new pump station.

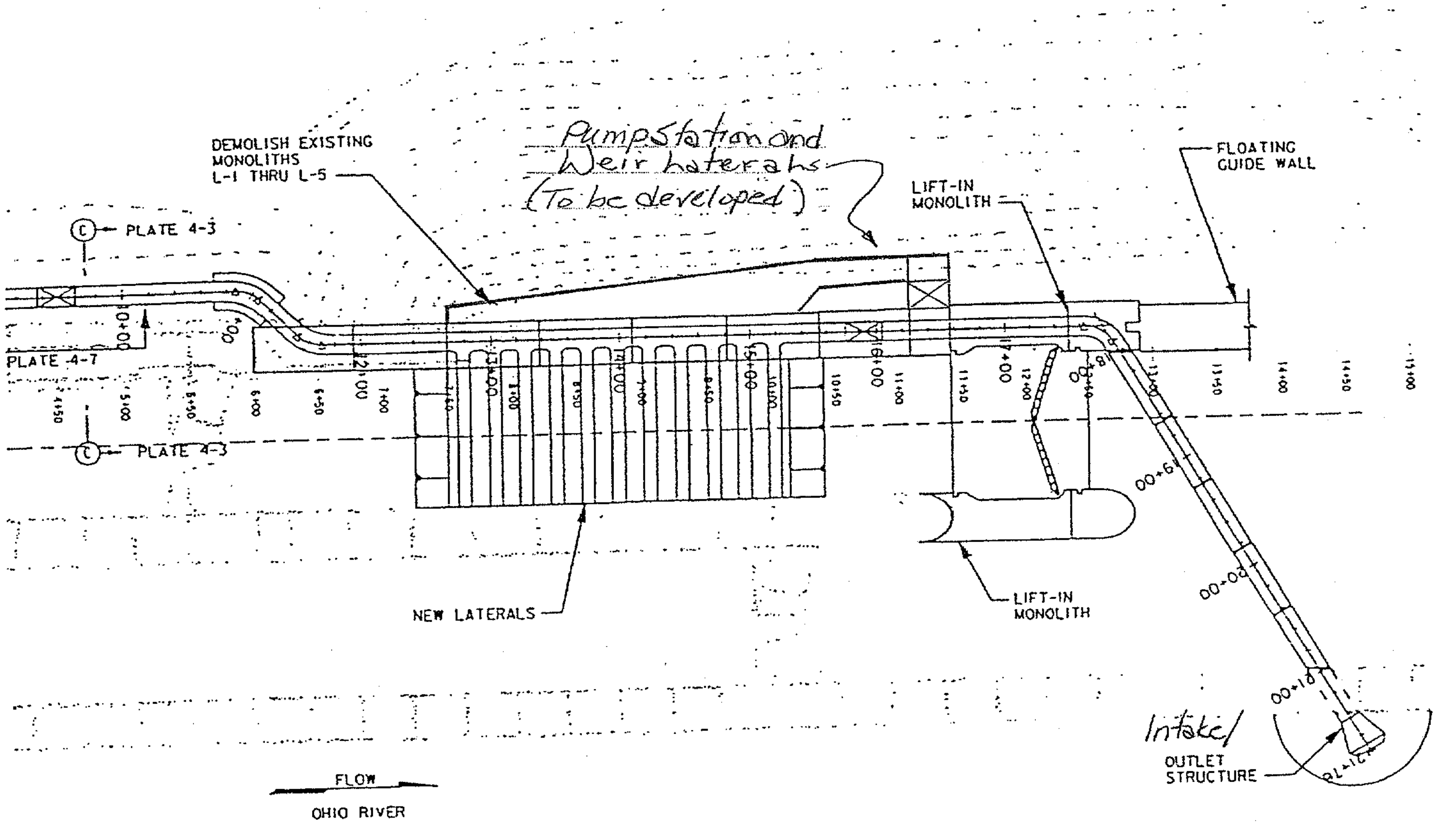
DRAWING NO 1:

CURRENT LOCK EXTENSION CULVERT SYSTEM AND PROPOSED SIPHON



DRAWING NO 2:

PARTIAL PLAN OF PUMPING STATION FILLING SYSTEM



VALUE ENGINEERING PROPOSAL

COST ESTIMATE WORKSHEET				
PROPOSAL NO.: C-20 Use a Downstream Pump Station for New Filling Capacity				PAGE 4 OF 4
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Plan 3 Filling/Emptying system	LS	1	$22,993,680	$22,993,680
Plan 2 Emptying system (remove Emptying)	LS	1	-$4,400,660	-$4,400,660
(Net costs for filling system results)				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$18,593,020
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Pump Station	CFS	1,600	$7,500	$12,000,000
Discharge / Weir Wall	LS	1	$500,000	$500,000
Pump Station O&M:				
(PW @ $125/CFS/Year X 14.7)	LS	1	$2,940,000	$2,940,000
(PW Replacement @ Yr 25 (.233 X$12M))	LS	1	$2,796,000	$2,796,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$18,236,000
		Net Cost Decrease		$357,020
	*	Mark-ups	0.00%	$0
		Total Cost Decrease		$357,020

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-21 PAGE NO: 1 OF 5
DESCRIPTION: Skirt Material

ORIGINAL DESIGN:

Skirts which hang below floating approach walls are currently designed to be stainless steel.

PROPOSED DESIGN:

Skirt material can be changed to either carbon steel or synthetic material.

ADVANTAGES:

1. Carbon steel: Cost reduction, easily manufactured.
2. Synthetic: Cost reduction, lighter, easier to handle, more impact resistant

DISADVANTAGES:

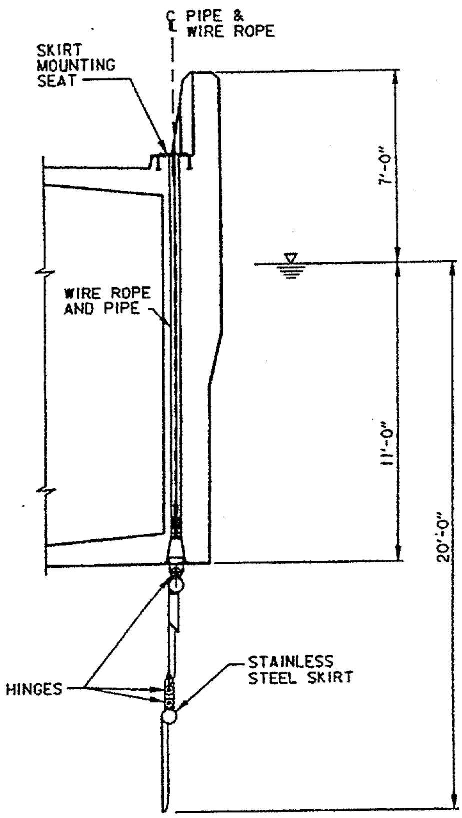
1. Carbon Steel: Has to be painted with vinyl or epoxy.
2. Synthetic: May be too buoyant.

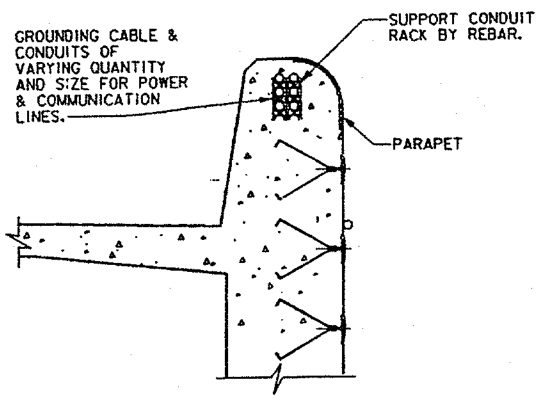
JUSTIFICATION:

Carbon Steel: Skirt will always be submerged and must be painted, but is still cheaper than stainless steel. Synthetic: No need to worry about degradation, lighter and easier to handle, and more impact resistant to debris.

DRAWING NO. 1

EXISTING DESIGN WITH STAINLESS STEEL SKIRTS

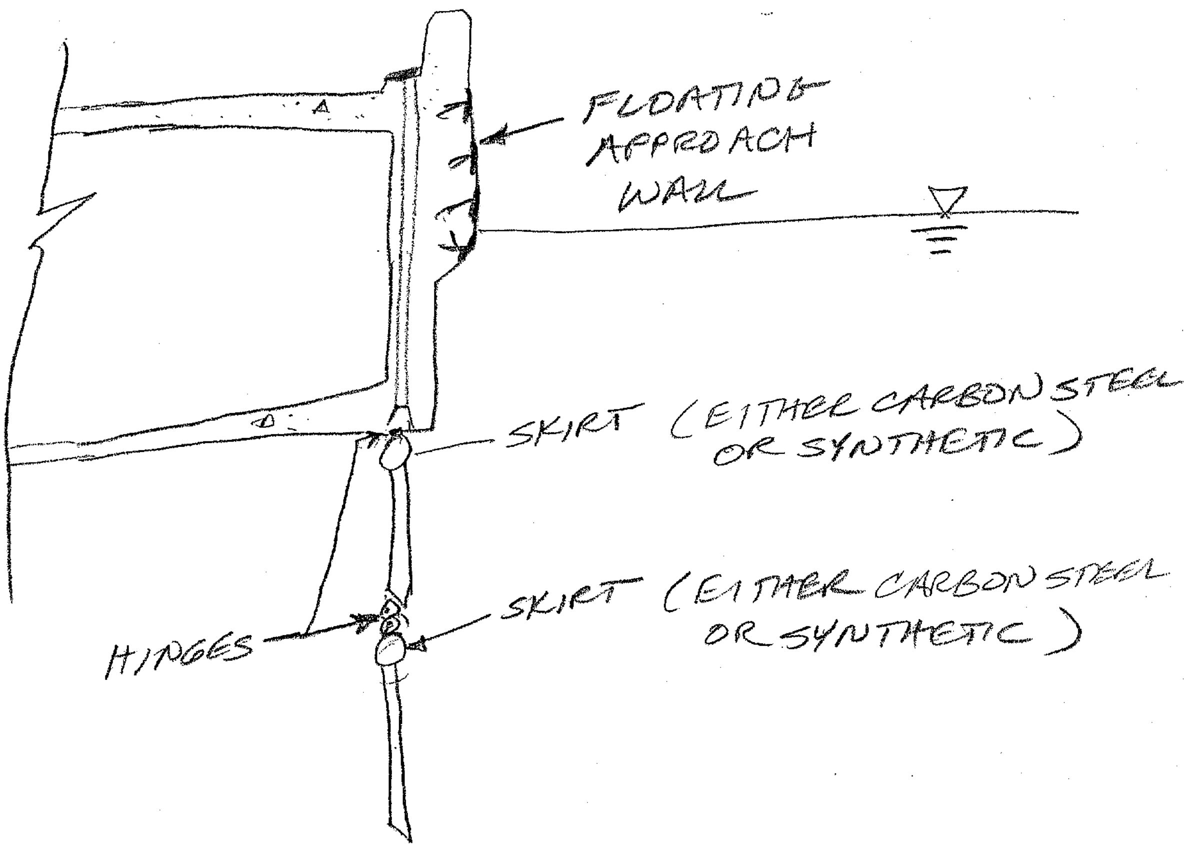




CONDUIT & GROUNDING CABLE IN PARAPET
SCALE: NTS

DRAWING NO. 2

PROPOSED DESIGN WITH CARBON STEEL OR SYNTHETIC SKIRTS



COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-21 Skirt Material

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Carbon steel				$0
Material difference	LB	307,771	$2.00	$615,542
				$0
				$0
				$0
				$0
		Total Deletions		$615,542

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$0
		Net Savings		$615,542
		Markups		$0
		Total Savings		$615,542

COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-21 Skirt Material				PAGE 5 OF 5

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
Synthetic material				
Material difference	LB	307,771	$4.15	$1,277,250
				$0
				$0
				$0
				$0
		Total Deletions		$1,277,250

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
				$0
				$0
				$0
				$0
				$0
				$0
		Total Additions		$0
		Net Savings		$1,277,250
		Markups		$0
		Total Savings		$1,277,250

PROPOSAL NO: C-22

DESCRIPTION: In-Floor Supplemental Filling/Emptying System

ORIGINAL DESIGN:

The original supplemental Filling/Emptying System design included two reverse tainter valves and a series of lateral culvert manifolds which pass through the land wall. The supplemental system also includes a cross-over culvert and outlet bucket.

PROPOSED DESIGN:

This design consists of one rotary valve to control the filling and emptying flow, longitudinal manifolds within the chamber and an emptying manifold located behind the land wall.

ADVANTAGES:

1. Eliminates the need of 1 valve (2 reverse tainter valves versus 1 rotary valve).
2. Only requires going through the land wall once.
3. Eliminates the need of the cross-over culvert and outlet bucket.

DISADVANTAGES:

1. Details of the rotary valve would need to be developed.
2. The design would require a physical model study.
3. Many of the design details are incomplete, but it is believed that hydraulic design can produce an acceptable system.

JUSTIFICATION:

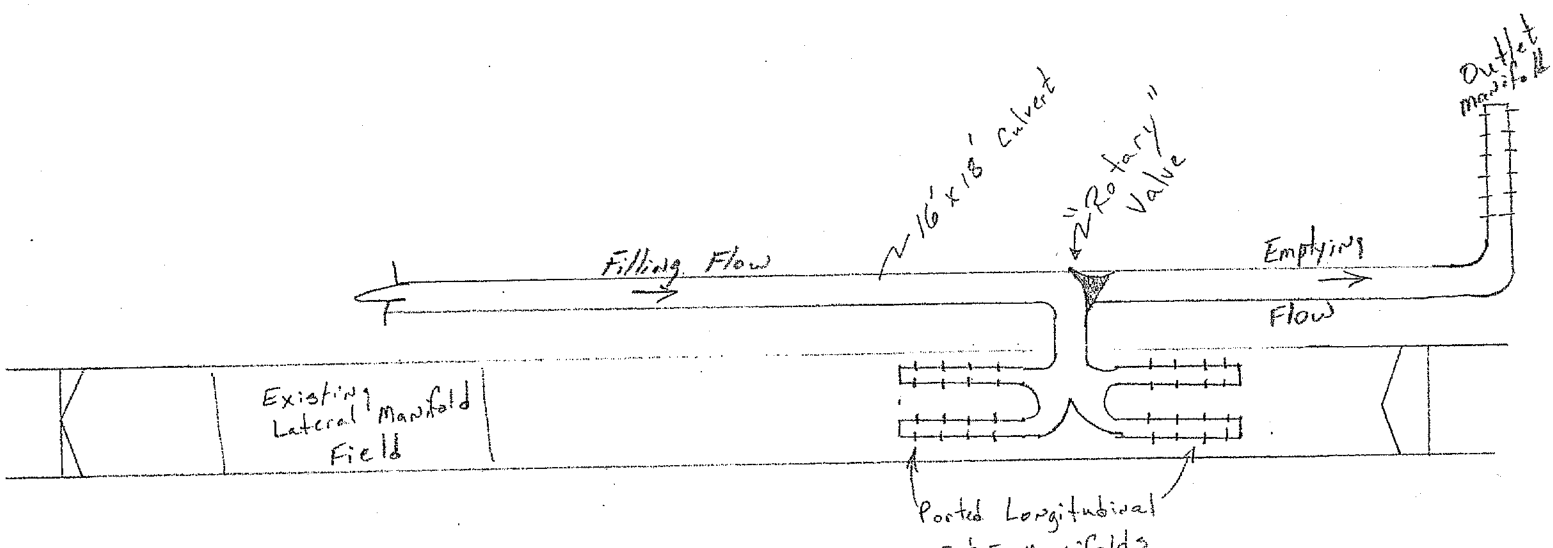
This proposal appears to be slightly less costly than the original design (potential savings of approximately $2,200,000). Details of this new valve technology may provide additional savings.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-22 PAGE NO: 2 OF 4

DRAWING NO. 1

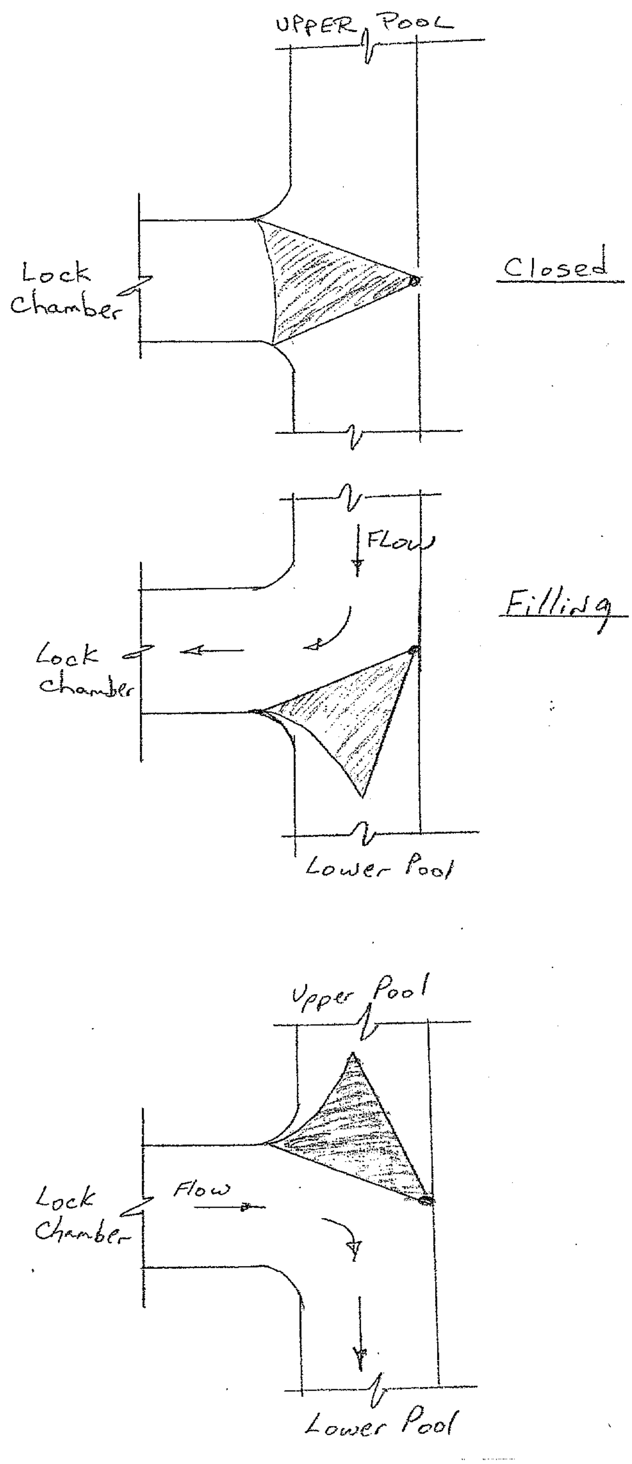
PROPOSED DESIGN WITH ROTARY VALVE



PLAN

DRAWING NO. 2

PROPOSED DESIGN WITH ROTARY VALVE



	COST ESTIMATE WORKSHEET				
	PROPOSAL NO.: C-22 In-Floor Supplemental Filling/Emptying System				PAGE 4 OF 4
	DELETIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Plan 3 F&E system	LS	1	$22,400,000	$22,400,000
					$0
					$0
			Total Deletions		$22,400,000
	ADDITIONS				
	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
	Longitudinal Culverts				
	(assume cost = lateral costs)	LS	1	$1,240,000	$1,240,000
*	Outlet Culvert				
	(assume CIP in units of length $2,312/LF)	LS	1	$1,250,000	$1,250,000
	Outlet Manifold				
	(assume = 1/2 cost of laterals)	LS	1	$620,000	$620,000
	Cut-off wall	LS	1	$540,000	$540,000
	Shoring for excavation	LS	1	$440,000	$440,000
	Cut-off wall	LS	1	$420,000	$420,000
	Excavation dry earth and haul	LS	1	$3,280,000	$3,280,000
	Screens and nose plate	LS	1	$530,000	$530,000
	Floating boom	LS	1	$1,230,000	$1,230,000
	CIP concrete - bypass culvert	LS	1	$3,700,000	$3,700,000
	CIP concrete - thrust blocks	LS	1	$500,000	$500,000
	Wells for de-watering	LS	1	$2,930,000	$2,930,000
	Intake structure and wingwalls	LS	1	$2,480,000	$2,480,000
	Sealing diaphrams	LS	1	$70,000	$70,000
	Tainter valve machinery and embedment	LS	1	$970,000	$970,000
			Total Additions		$20,200,000
			Net Savings		$2,200,000
			Mark-ups	0.00%	$0
			Total Savings		$2,200,000
*	The unit cost of CIP concrete is suspect				

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-23 PAGE NO: 1 OF 3

DESCRIPTION: Through-the-Sill Filling/Emptying System

ORIGINAL DESIGN:

Original design included construction of a land-based intake structure, filling culvert, two reverse tainter valves, a field of lateral manifolds in the chamber floor, and a cross over emptying culvert with outlet bucket.

PROPOSED DESIGN:

This proposal calls for intakes being located in the upper miter gate sills, and culverts under the sill and running below the lock floor (destruction of existing laterals) longitudinally along the length of the chamber. These culverts are ported at the upstream and downstream 1/3 points along the length of the chamber. The culverts continue under and through the lower miter sill and terminate at the miter sill face.

ADVANTAGES:

1. Eliminates the need for placing a filling culvert on the land, two reverse tainter valves, a field of lateral manifolds, cross over culvert, and outlet bucket.

DISADVANTAGES:

1. Requires careful consideration of operation and maintenance associated with the filling and emptying valves because the mechanisms will be located under water.
2. Excavation of the existing lock chamber floor for placement of the In-chamber Longitudinal Culvert System (ILCS).
3. Would require further investigation regarding vortex tendency at the intakes and the effect that emptying the lock within the navigation channel has on vessels.

JUSTIFICATION:

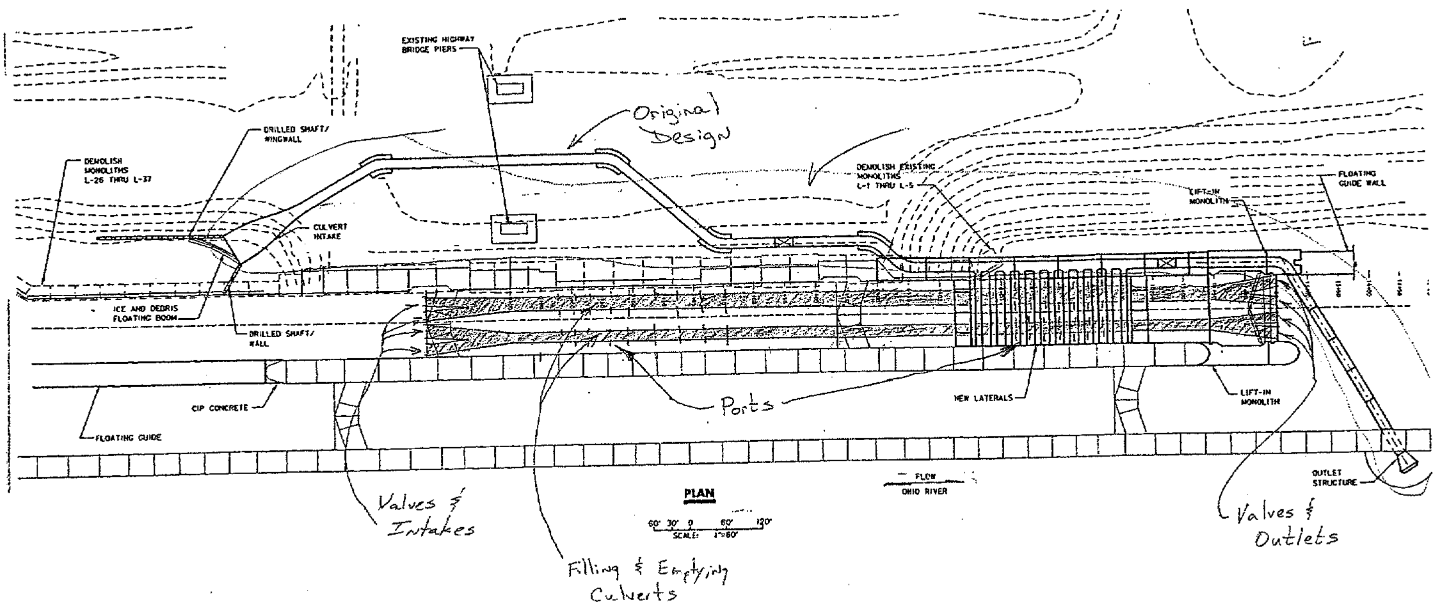
This proposal is estimated to cost approximately $10,200,000 less than the original design.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-23 PAGE NO: 2 OF 3

DRAWING NO. 1

PROPOSED DESIGN WITH THROUGH-THE-SILL ILCS



PLAN 3

Through-the-sill ILCS

COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-23 Through-the-Sill Filling/Emptying System

PAGE 3 OF 3

DELETIONS

ITEM	UNIT	UANTIT	UNIT COST	TOTAL
Plan 3 F&E system	LS	1	$22,400,000	$22,400,000
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$22,400,000

ADDITIONS

ITEM	UNIT	UANTIT	UNIT COST	TOTAL
Rock excavation for culverts				
(assume $/LF same as original) $1,650/LF	LS	1	$4,460,000	$4,460,000
Butterfly valves				
(assume cost of several small valves = 2 tainters)	LS	1	$970,000	$970,000
Longitudinal culverts				
(assume $/LF same as CIP concrete) $2,312/LF	LS	1	$6,240,000	$6,240,000
Intake trash rack(s)				
(assume same as Plan 3)	LS	1	$530,000	$530,000
		Total Additions		$12,200,000
		Net Savings		$10,200,000
		Mark-up	0.00%	$0
		Total Savings		$10,200,000

* The unit cost of excavation and CIP concrete is suspect.

** Intakes in the sill will require design consideration and could be significantly more expensive than estimated.

PROPOSAL NO: C-24
DESCRIPTION: Use Standard Lighting versus High-Mast Lighting

ORIGINAL DESIGN:

Standard Roadway lighting is shown.

PROPOSED DESIGN:

Use high-mast lighting. Use LED/Solar lighting for walkways.

ADVANTAGES:

1. Assembly and mounting of one pole.
2. Higher foot-candle values with reduced energy consumption.
3. Lower maintenance cost.

DISADVANTAGES:

1. Standard lighting increases the number of lockwall obstacles.
2. Increases wiring, installation, erection cost.

JUSTIFICATION:

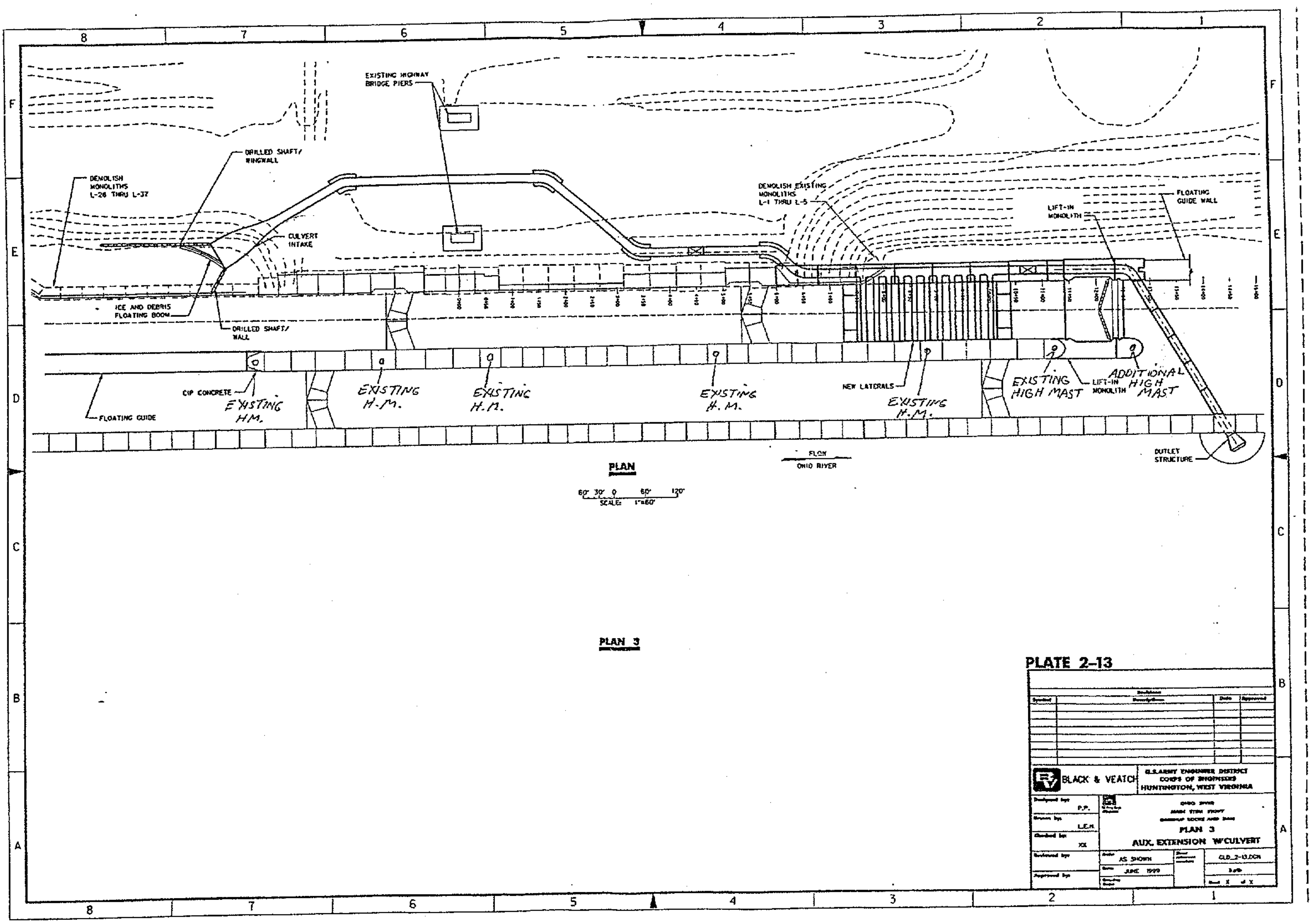
High-mast compliments the existing lighting system. There would be no inventory increases due to incompatibility of parts. It would provide the same level of lighting safety.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: C-24 PAGE NO: 2 OF 4

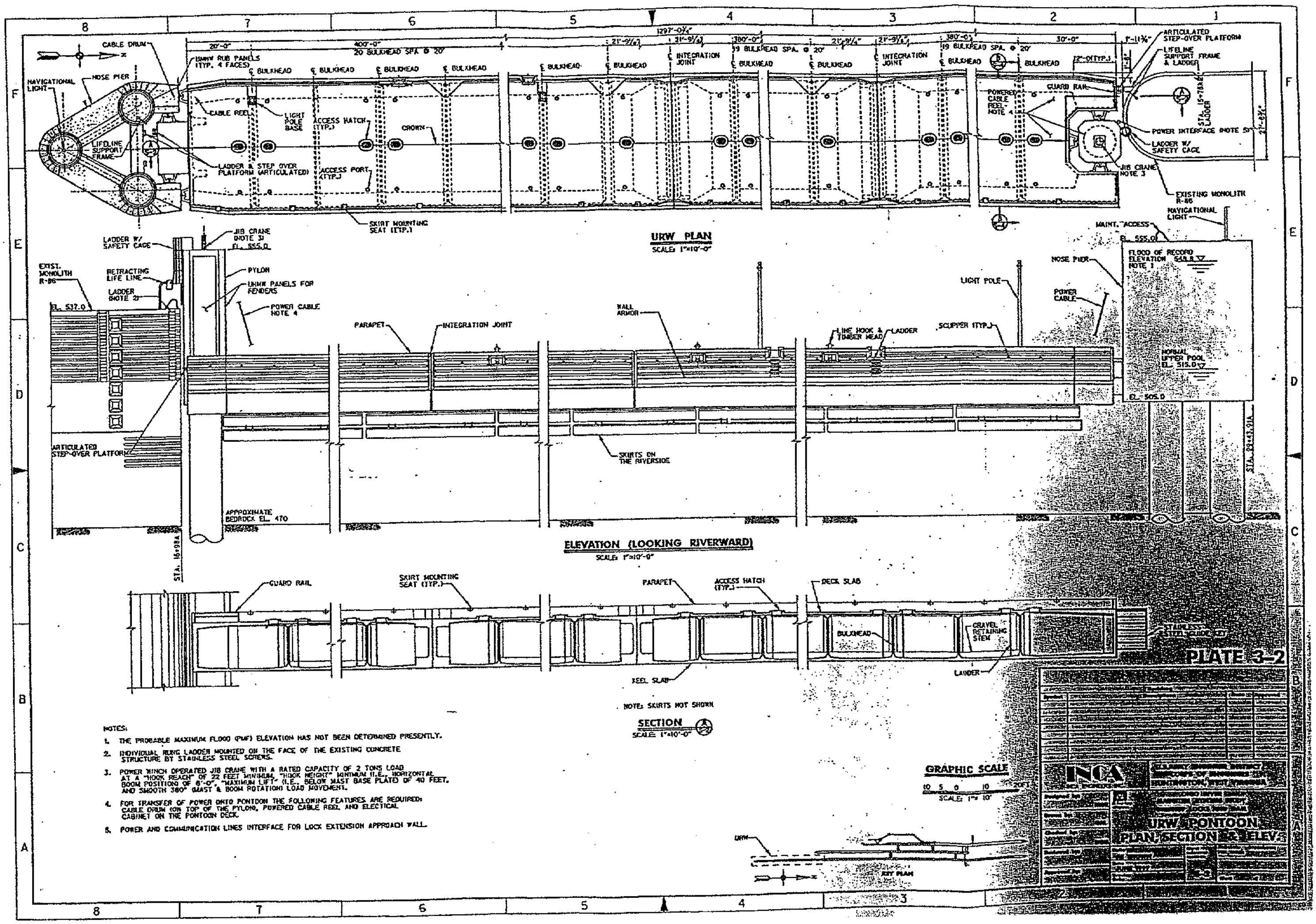
DRAWING NO. 1

EXISTING DESIGN



DRAWING NO. 2

PROPOSED DESIGN



COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-24 Use Standard Lighting versus High-Mast Lighting

DELETIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Roadway lighting	LS	18	$10,000.00	$180,000
				$0
				$0
				$0
				$0
				$0
		Total Deletions		$180,000

ADDITIONS

ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
High-mast lighting	LS	1	$60,000.00	$60,000
				$0
				$0
				$0
				$0
				$0
		Total Additions		$60,000
		Net Savings		$120,000
		Mark-ups	0.00%	$0
		Total Savings		$120,000

(Refer to 05.00.66.16.970 Cost Estimate)

DESCRIPTION: Reduce Number of Armor Strips on Guide Wall

ORIGINAL DESIGN:

Floating Guide Wall pontoons have four strips of wall armor spaced at 1'-8" on center.

PROPOSED DESIGN:

Reduce armor to three strips spaced at 2'-6" on center.

ADVANTAGES:

1. Reduced quantity of metal armor required.
2. Reduced maintenance and painting of armor strips.

DISADVANTAGES:

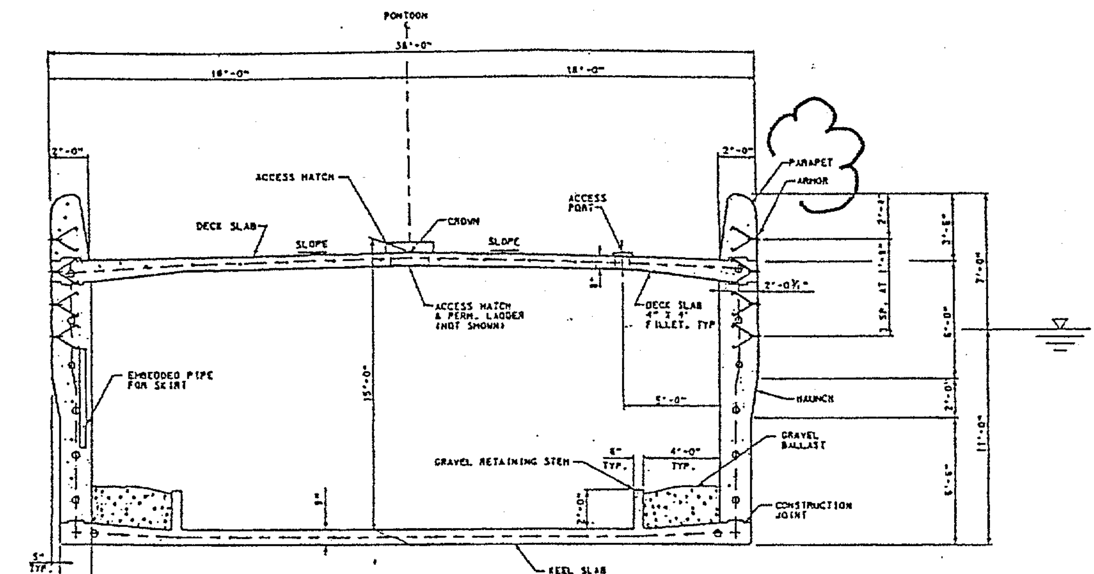
1. None apparent.

JUSTIFICATION:

Armor appears to be spaced too closely. Dimensions should be more closely match those of the width and centerline spacing of armor strips on the existing lock walls.

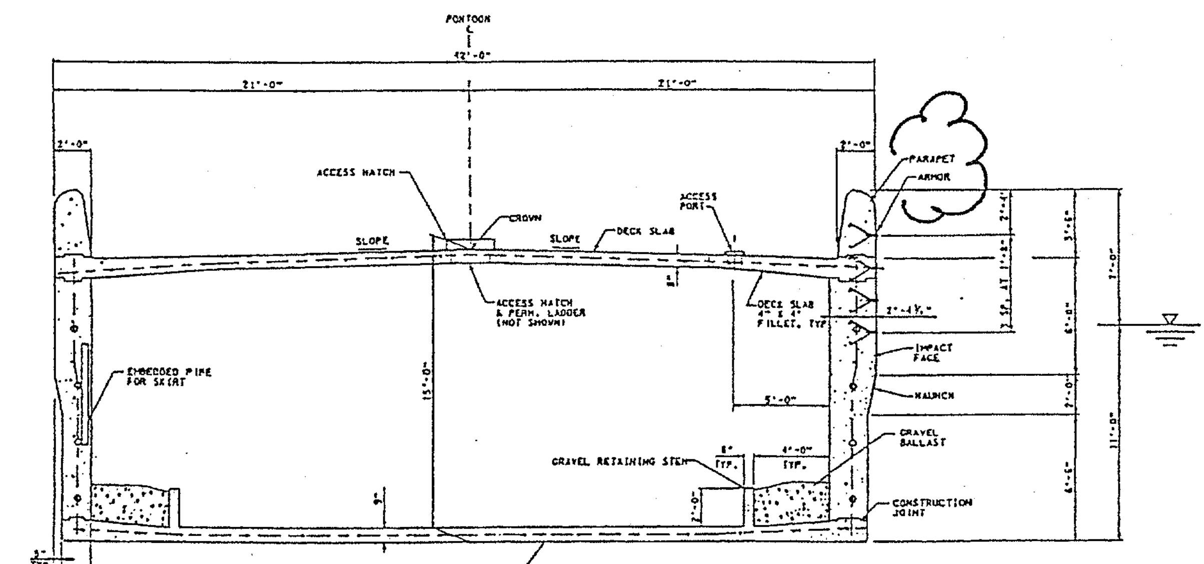
DRAWING NO. 1

EXISTING DESIGN WITH FOUR STRIPS OF ARMOR



UPPER MIDDLE WALL CROSS SECTION

SCALE: 1/4"=1'-0"

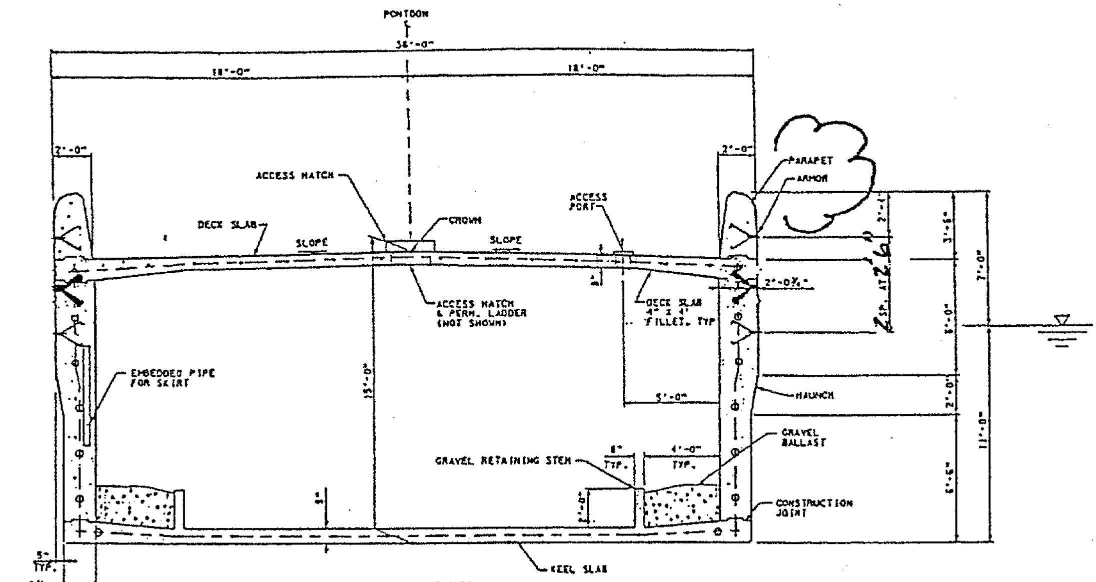


UPPER RIVER WALL CROSS SECTION

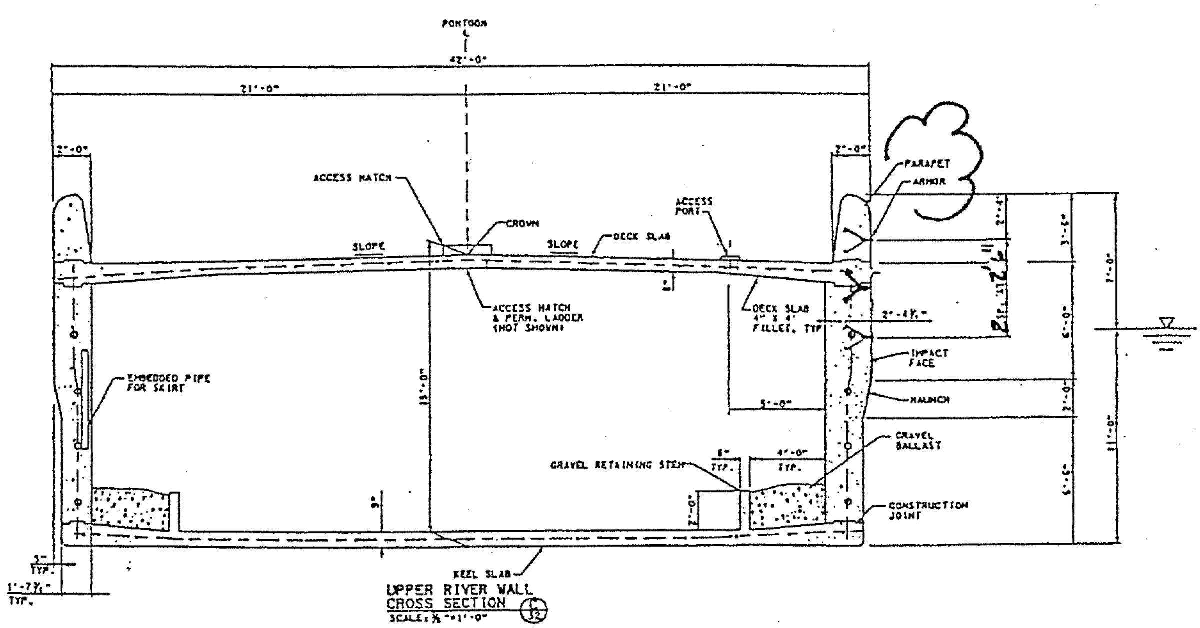
SCALE: 1/4"=1'-0"

DRAWING NO. 2

PROPOSED DESIGN WITH THREE STRIPS OF ARMOR



UPPER MIDDLE WALL CROSS SECTION



UPPER RIVER WALL CROSS SECTION

VALUE ENGINEERING PROPOSAL

COST ESTIMATE WORKSHEET

PROPOSAL NO.: C-25 Reduce Number of Armor Strips on Guide Wall

DELETIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
**	Wall armor (24% less)	%	0.25	$963,915	$240,979
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Deletions		$240,979

ADDITIONS

	ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
					$0
			Total Additions		$0
			Net Cost Decrease		$240,979
		*	Mark-ups	0.00%	$0
			Total Cost Decrease		$240,979

** Direct cost $795,449 plus 21% profit and overhead = $963,915

1. **<u>Eliminate Cathodic Protection. (Speculation List Item 69):</u>** 21.2 Lock Walls "local cathodic protection system will be provided for each gate leaf to offset the corrosive effects of this mass of CRS. Magnesium marine anodes will be provided in each compartment below water level on each side of each gate leaf, at both quoin & miter ends. Anodes will be mounted on threaded studs welded to the gate for ease of placement." Designer may want to consider using carbon steel quoin & miter blocks to reduce the need for cathodic protection. After discussion with operations maintenance personnel, it appears that quoin & miter blocks are not typically replaced because of corrosion. They are typically replaced because of drift damage. The reason for the cathodic protection is the stainless steel block & dissimilar metals. By eliminating the stainless steel blocks, you eliminate the need for a local cathodic protection system. Cost reductions can be realized for the material difference between stainless steel and carbon steel as well as the elimination of the local cathodic protection system.

2. **<u>Upgrade Cathodic Protection System and Use Active Cathodic Protection System. (Speculation List Items 67 and 68):</u>** After considering comment # 69 "Eliminate Cathodic Protection System" these comments are unnecessary. Comment # 69 is recommended.

3. **<u>Construct in-the-dry. (Speculation List Item 49):</u>** Construction in the dry has come advantages compared to lift-in:
   - Inspection of rock surface area is easy and safe.
   - Construction cost are lower and joints for the culvert can be constructed easier.

   One solution to combine construction in the dry with lift-in is:
   - Refer to Proposal C-12 Drawing No.1.

   Change the sequence to:
   - Lift-in concrete level frame.
   - Grout; remove silting frame.
   - Lift-in panels and place bracing.
   - De-water between walls.
   - Inspect and clean rock surface.
   - Build culvert.
   - Place CIP concrete pours 7 to 8.

4. **Rip-Rap All Graded Slopes or Use Control Hat (Speculation List Items 32 and 34):** The proposed plans are vague about identifying areas requiring stone slope protection (SSP) versus bio-engineered protection. It has been identified that either system is subject to failure if placed wrong. No information is available on geo-textile fabric bank stabilization. For informational purposes, the bio-engineered system is used as part of the mitigation plan.

5. **Cover R.C.B. and Develop into a Production Facility. (Speculation List Items 78 and 79):** The future of the dry dock as a maintenance facility is very promising. It is anticipated that sand blasting and painting can be performed in the dry dock area if a rolling (removable roof) can be installed and used as an enclosure. Further development of the facility to include electric, air, water, and sewage would eliminate the need to use portable generators to power equipment, and would enable workers to maximize their time. It is anticipated that 80 miter gate leaves will enter the facility over the next 20 years and each will require structural repairs, blasting, and painting. The District also has 30 tainter gate type culvert valves on a seven year rotation schedule.

   It does not appear to be feasible or (politically feasible) to lease the facility to private industry. However, Louisville District will be very interested in using the dry dock for the heavy gate lifter.

6. **Leave 600' Miter Gate in Place (Speculation List Item 5):** 20%-30% utilization for small tows, recreational craft , and scheduled passenger boats. Minimal cost to implement. Provides fast, easy, and cheap closure method to de-water half of the chamber. Reduces water unsafe in low-low flow conditions, lowering impact on ability to maintain navigable pool and hydro unit generation. Cost of filling in recesses cost of removal and relocation exceeds installation hydraulic lines, forming of concrete dry crossover tunnel, sum pump system.

7. **Enlarge the Opening at the Check Post and locate them at the Floating Bitts. (Speculation List Item 39):** Allows deckhands to check tow momentum on fixed pins instead of floating mooring bits. Enlarged openings make line placement easier. Confusion by recreational users can lead to accidents. Add columns of check pins on approach side of miter gates.

8. **Winch Barges to Avoid Backwash. (Speculation List Item 47):** Eliminate barge strikes during construction. Eliminate total lock closure. Eliminate underwater working hazards and material disruptions. Implement tow width restrictions width and draft equals displacement velocity. Use contractor supplied harbor boats allows them to create their own positive or adverse conditions. Allows continuous or near continuous operation reducing impact to customers.

9. **Design/Fund/Build Floating Crane to Make Floating Approach Walls. (Speculation List Item 51):** Floating approach walls are not desired by the towing industry or operations. Unproven design in these operating conditions i.e., 50' + vertical movement drift, debris, and ice. Design structure to free fall 30'. This could be a early maintenance free design. Cost savings from reduction of approach walls used to build fixed gravity wall. Design, fund, and build pier mounted hoist. Entire structure is built with moving equipment contingencies.

10. **Provide supplemental culvert on lock chamber floor. (Speculation List Item 27):** This proposal is similar to the option that is being investigated as part of the JT Myers F/E model that is presently being tested at WES. This option involves providing water to the extended portion of the chamber by adding supplemental culverts that are formed into the lock floor. The intake would have to be through the upstream sill. This intake could either be controlled by butterfly valves below the sill or provide the valves in the extended portion of the land wall. In addition, the existing lower miter gate sill would need to be taken out in order to provide room for the supplemental culverts. This works well at the JT Myers site, but there are problems associated with the Greenup site. One of these problems is the large emergency miter gate sill upstream of the miter gate. This could cause problems regarding volume of water available for the intakes and this would have to model tested. Secondly, there is a clearance issue that does not allow for very large culverts to be placed on the floor. The lock floor would need to be excavated in order to get supplemental culverts into the system. In addition, the cross-over culvert for the 600-ft chamber is in the way. A portion of this would probably need to be blocked out if supplemental culverts are provided. This may be acceptable, but again would require testing if this option becomes a reality at Greenup. It has been agreed that this is a very attractive alternative for any extension project at Meldahl.

11. **Provide culvert bulkhead recesses both upstream and downstream of the culvert valves. (Speculation List Item 43):** This is a design comment. Presently, the design calls for bulkhead recesses on one side of the valves only. In order to de-water the valve pit only for maintenance, valve bulkhead recesses should be placed on both sides of the culvert valve.

12. **Review/increase allowable hawser force criteria. (Speculation List Item 70):** This proposal can obviously not be answered with this VE Study, but it has large implications on the design and thus, the construction and operating cost. Everyone in the group agreed that hawser forces in the field are occurring that are larger than the 5-ton limit. Faster empty/fill times can be achieved with faster valve operating timing if the 5-ton limit is relaxed. This could really effect the option where no supplemental filling or emptying system is provided or where smaller supplemental culverts could be provide that would give adequate filling and emptying times. As stated earlier, a relaxation of the conservative 5-ton guidance would require some direction from HQUSACE.

13. **Two-speed fill system. (Speculation List Item 74):** This proposal suggests having two different filling speeds for the chamber, one for commercial traffic and a slower time for recreation traffic. This one is related to the 5-ton hawser force limit. If this criteria could be relaxed, faster fill times could be achieved for commercial lockages, but the slower times would still be used for recreational lockages. There are some drawbacks to this issue such as having to use two different valve operating timings for different types of lockages. In addition, the 5-ton criteria would need to be increased for commercial lockages. Again, direction from HQUSACE would be required for any relaxation of criteria.

14. **Use deflector dikes to modify currents. (Speculation List Item 91):** This proposal calls for the use of deflector dikes to modify currents for the approaches into the lock chamber. This option could increase the construction cost, but would be used to improve approach conditions. Improved approach conditions could increase the overall benefit to the project. The deflector dikes can also influence the type and length of the approach walls. This proposal can only be addressed with the navigation model that will be constructed for Greenup at WES. The navigation industry will be involved with these discussions.

15. **Redesign middle wall nose pier using a vertical slope. (Speculation List Items 26 and 29):** The current design requires a straight bull nose for the middle wall nose pier. The VE team recommends a vertical nose pier with a 15 degree slope. The vertical pier will allow a barge to impact the nose pier and travel up the slope, thereby dissipating the load which will reduce pier damage. This modified design will reduce life cycle costs for the nose piers. These modified piers have been used on other locks on the Kanawha River in the Huntington District and have been in service for over 60 years with minimal damage under heavy traffic conditions. The vertical nose pier section (with a 15 degree slope) is wider at the base and is tapered inward as the section rises vertically. Slip-form construction will facilitate the construction of the modified vertical pier, thereby adding value and reducing costs.

CONTACT DIRECTORY

APPENDIX A: CONTACT DIRECTORY

NAME	ORGANIZATION	TEL/FAX NUMBERS
Eric Dolly	GRO	606-473-7441/6066
James (Arnie) McCoy	EC-TC	304-529-6941
Richard Stockstill	ERDC-CHL	603-646-4851/4477
Sean Smith	CELRH-EC-WH	304-529-5523/5960
Darin White	CELRH-RC-RCB	304-576-9901/2624
David Carter	CELRH-OR-P	304-529-6971/5159
Greg Jones	CELRH-EC-TI	304-528-7474/5960
Lisa Pierce	INCA	425-635-1000/1150
David Schaaf	CELRL-ED-DS	502-315-6297/6493
Thomas Sully	CEMVP-ED-D	651-290-5573/5805
Henkjam Berkhoff	DMC	++31182590636
Jose Van Rijen	DMC	+31182590455
John Koontz	BLACK & VEATCH	913-458-9028/6333
David Conley	CELRH-EC-DC	304-529-5414/5209
Warren Withers	OVEST	912-652-5958/5956
Eara Merritt	OVEST	912-652-5171/6011
Charles Claghorn	OVEST	912-652-5173/6011
Fred McAuley	OVEST	912-652-5715/6011

SPECULATION LIST

VALUE ENGINEERING STUDY				
GREENUP LOCK REPLACEMENT				
HUNTINGTON DISTRICT				
FEBRUARY 12 - 16, 2001				
SPECULATION & ANALYSIS LIST				
			PROPOSAL LIST	Potential Savings
1	√		Eliminate all approach wall extensions (See 2 & 3)	24,301,524
2	√		Shorten all approach walls (See 1 & 3)	See 1
3	√		Use upstream guidewall, eliminate middle wall and landwall system (See 1 & 2)	See 1
4	X		Heat water in winter	Void
5	C		Leave 600' gate in place	
6	√		Eliminate the downstream river wall extension	See 1
7	X		Use open channel for fill system	Void
8	X		Don't build bypass, build new lateral to system	Void
9	√		Add sluice gate & culvert to empty dry dock	
10	√		Eliminate emptying cross-over and dump into landside diffusers (see 12)	2,750,000
11	√		Eliminate supplemental filling system	18,000,000
12	√		Route the empty system along the landside guidewall (See 10)	See 10
13	X		Long slot discharge perpendicular to sill, downstream Covered by 10 & 12	Void
14	C		Use iron pellets for in-fill	
15	√		Compare float-in vs. lift-in	700,000
16	√		Use 150 psi concrete for fill	
17	√		Make entry point at end of existing monolith	2,750,000
18	√		Place culvert behind landside wall (See 105)	2,590,740
19	√		Use siphon (See 38 & 108)	11,853,000
20	X		Trash removal system	Void
21	X		Construct in-fill in the slab, build landside system at a later time	Void
22	X		Use the existing plum, then tie-in to the middlewall	Void
23	X		Eliminate the ability to dewater	Void
24	X		Don't backfill behind landside wall	Void
25	X		Enlarge existing culvert	Void
26	C		~~Extend~~ Reshape middle wall bullnose	
27	C		Supplemental culvert on lack chamber floor	
28	X		Use steel sheetpile for nose pier (concrete fill)	Void
29	C		Use a vertical slope on nose pier (See 26)	
30	X		Flexible approach walls	Void
31	X		Place Place a cable restrain system in chamber in lieu of extending middle wall	
32	C		Riprap all graded slope	
33	X		Use a cable restraint and fill from upstream	
34	C		Use erosion control mat in lieu of Riprap	
35	√		Incorporate the fill valve into the landwall extension	1,000,000
36	X		Eliminate mooring bits and use a winch	Void
37	√		Through sill filling and empty system (See 41)	10,200,000

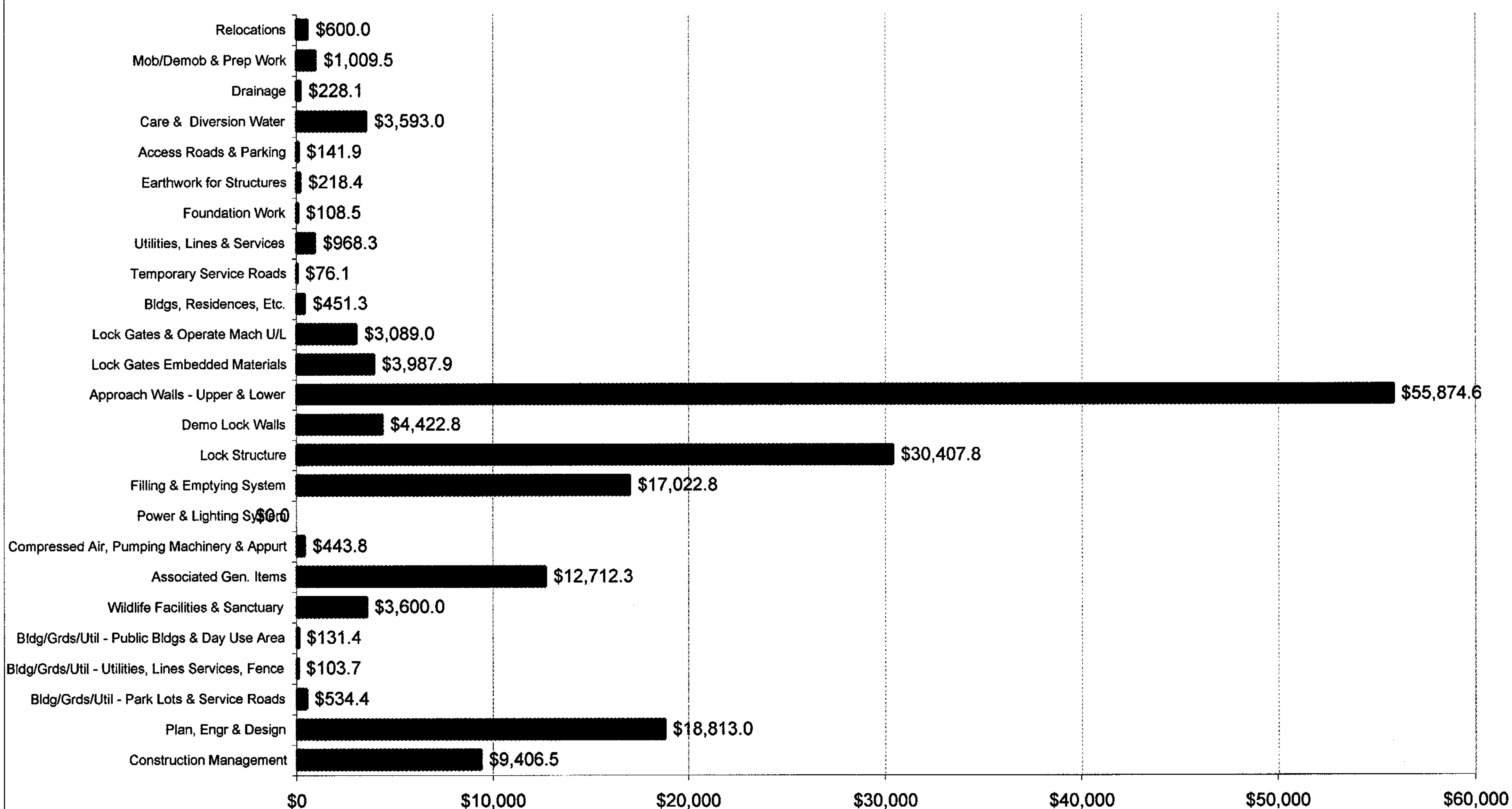
38	√		Replace buried pipe with siphon (See 19 & 108)	See 19
39	C		Enlarge the opening at the check posts and locate them at the floating bits	
40	√		Install sluice gates , or fill valve in Byrd closure walls	
41	√		Replace existing fill/empty system with Marmet style system I.L.C.S. (See 37)	See 37
42	X		Use fly-ash filled vs. RCP concrete	Void
43	C		Put culvert bulkhead recess up/down stream of valves	
44	√		Use downstream pumping station to fill the chamber and leave empty system alone	357,000
45a	√		Reconstruct the drilled shaft wall	3,957,000
45b	√		Reconstruct the drilled shaft wall	900,000
46	√		Use tin tin can concept for bullnose	1,700,000
47	C		Winch barges to avoid backwash	
48	X		build sheetpile wall as part of banks	Void
49	C		Use alternative lift-in wall design where rack is inspected in the dry as well at the culvert	
50	X		Use float-in barge walls for guide/approach walls	Void
51	C		Design/fund and build use floating crane to make floating approach walls	
52	C		Put incentives in construction to min. downtime (See 59)	
53	X		Use gate lifter as a crane for construction	Void
54	C		For economy of scale build central facility for concrete and steel fabrication of lock element -future lock construction	
55	X		Build concrete Lego lock (maybe hollow, concrete filled)	Void
56	X		Use RCC for a new 1200' lock landwall extension	Void
57	√		Use standard lighting vs. high mast lighting	120,000
58	X		Use auxiliary lock as a dry dock, use land as staging area	Void
59	C		Use liquidated damages for contract for delays (See 52)	
60	BD		Use tin can on lower guidewall	
61	X		Float/flip wall sections	
62	√		Float-in bullnose section	See 46
63	C		Barge and winch system to float-in approach walls	
64	X		DESIGN-BUILD	Void
65	C		Use jacks to position wall panels	2,200,000
66	√		Use Richard's system for fill/empty (In-floor F/E with single rotary landside valve and modified thin or drilled shaft landwall)	
67	C		Upgrade cathotic system (See 68 & 69)	
68	C		Use active cathotic system (See 67 & 69)	
69	C		Eliminate cathotic system (See 67 & 68)	
70	C		Review/increase hawser forces	
71	√		Place culvert parallel to landwall between landwall and bridge pier (See 18 & 19)	See 18
72	X		Use kicker gates in miter gates	Void
73	X		Use existing chamber as a second filling valve, middle wall fill	Void
74	C		Two speed fill system	
75			Reduce armor and increase spacing between approach walls and chamber	
76	X		Provide wheels on barges	Void
77			Provide wheels on walls and chamber	
78	C		Cover R.C. Byrd, dry dock and develop into production facility (See 54)	

79	C		Lease out dry dock facility when not working on Government projects (See 54)	
80	C		Lift-in, separate culvert from towers, culvert first then towers	
81	X		Alternate lift-in techology (See 45, 55 & 101)	Void
82	X		Float-in culverts	Void
83	√		Use excavated rock for cell fill ~~and bank protection~~ (See 16, 33 & 34)	4,654,500
84	√		Use synthetic wall armor vs. steel	1,170,189
85	C		Install rail spur for materials	
86	C		Install dock for material delivery	
87	X		Install traveling kievel from end to end	Void
88	X		Use regular barges for floating guidewalls	Void
89	C		Increase approach width by excavating towards bank (Note for Nav model)	
90	X		Use small RCP for nose pier pile group	Void
91	C		Use deflector dikes to modify currents (Nav Model)	
92	C		Use tripod pile and rails for support of floating walls (See New Orleans wall)	
93	C		Use slip-forms for walls (See 15)	
94	√		Pump to fill/empty from down stream (See 44)	
95	X		Use sluice-well-sluice to fill/empty (See 44)	Void
96	X		Pump to fill/empty from a reservoir (See 44)	Void
97	X		Pump to/from chambers	
98	√		Use carbon steel for skirts vs. stainless	1,277,250
99	√		Use synthetic skirts (See 98)	See 98
100	X		Backfill the landside wall extension	
101	√		Prefab concrete sheetpile panels in pre-laid gutter (See 40,49 & 81)	991,800
102	C		Half-size precast bullnose section	
103	X		Store spare gates at Louisville (Smithland)	
104	√		Straighten culvert	
105	√		Culvert next to lock wall - microtunnel at tower or shore against lock wall (See 18)	See 18
106	√		Manifold intake on upstream side wall	3,617,063
107	X		Eliminate the new Fill/empty and relocate existing to the middle of chamber	Void
108	√		Above ground siphon with pump assist	See 19

COST MODELS

GREENUP AUXILIARY LOCK EXTENSION

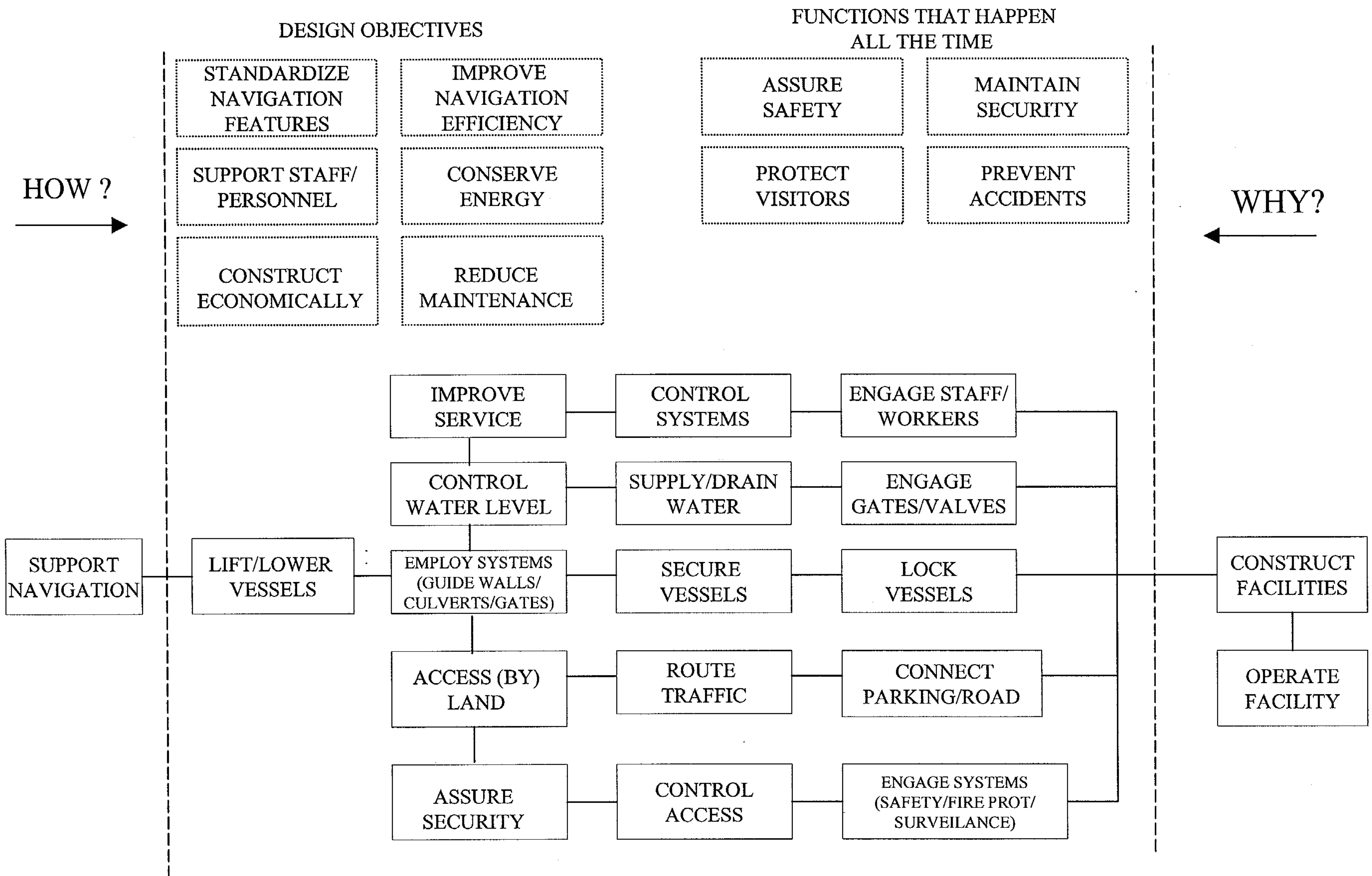
PRIMARY FEATURES - PLAN 3 ($167.9 MILLION COST MODEL)



($000 X THOUSAND)

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

GREENUP AUXILIARY LOCK IMPROVEMENTS



FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST DIAGRAM)